

# COMPUTERS

*a n d* A U T O M A T I O N

DATA PROCESSING • CYBERNETICS • ROBOTS

No. 2

**Medical Diagnosis by  
Computer**

**Buy, Lease, Share a  
Computer---Or Utilize  
a Service Bureau?**

**The Working Group  
for Better Education**

**A Survey of European  
Computers  
(Part 1)**

No. 2 B

**News of Computers  
and Data Processing:  
ACROSS THE EDITOR'S  
DESK**

**FEBRUARY**

**1960**

•

**VOL. 9 - NO. 2 & 2B**



BOEING AIRPLANE CO.  
INDUSTRIAL PRODUCTS  
DIVISION LIBRARY

# SPACE TECHNOLOGY

OFFERS WORK OF THE FUTURE...TODAY

*Computer Programmers*

*and Applied Mathematicians!*

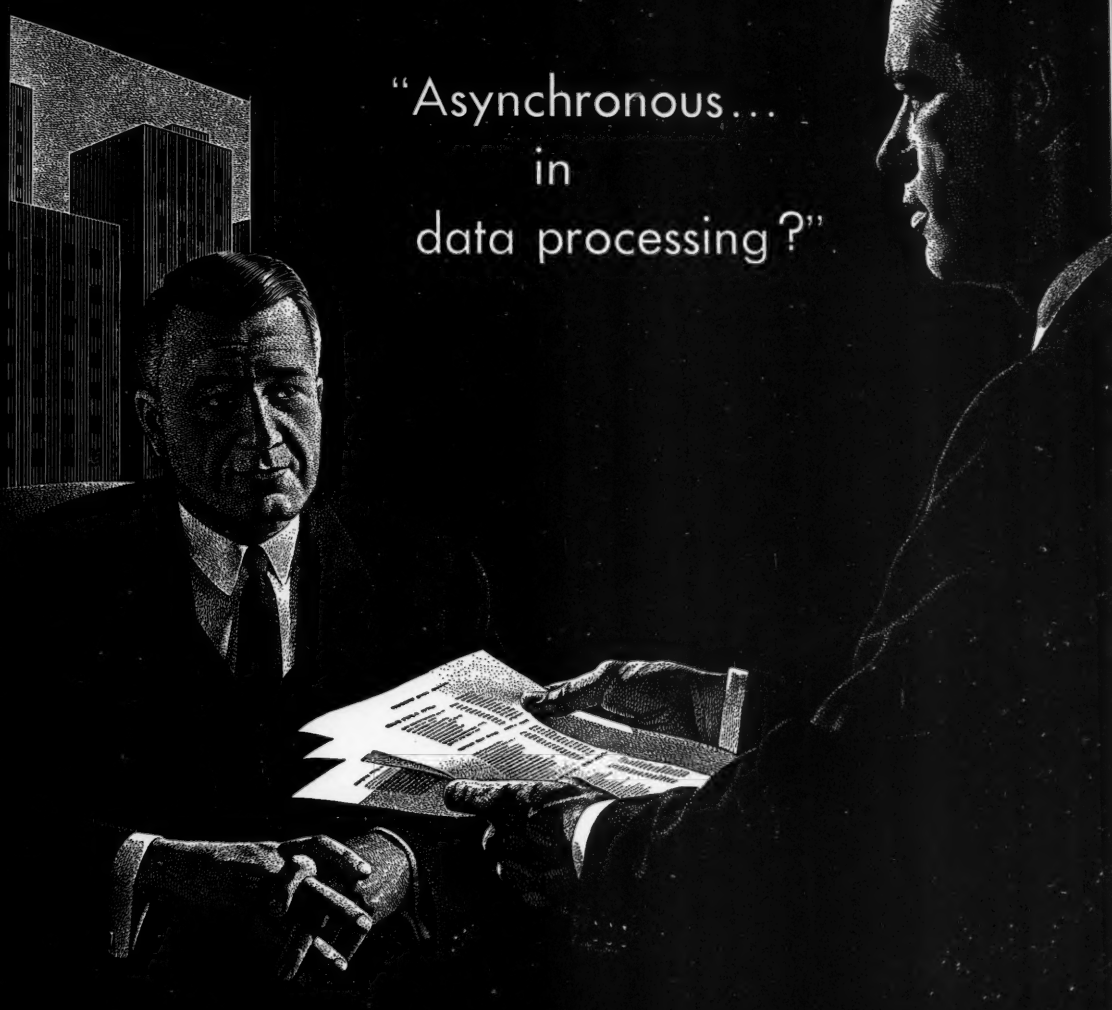
High speed digital computers and expanding computing and data handling systems require individuals with more than the usual amount of interest and ability in the fields of Applied Mathematics and Scientific Programming.

Our Computation and Data Reduction Center in Southern California is one of the largest and most advanced facilities in the nation. Outstanding R&D facilities, a creative atmosphere, and participation in some of the most challenging computation and data reduction problems offer optimum individual satisfaction at STL. The individual members of our Technical Staff are extended opportunities for project responsibility and personal advancement. Resumes are invited.



SPACE TECHNOLOGY LABORATORIES, INC.

P.O. BOX 95004, LOS ANGELES 45, CALIFORNIA



“Asynchronous...  
in  
data processing?”

Absolutely! Asynchronous is one of the most important words in data processing. It means faster computing and freedom from obsolescence. The Philco 2000 is the only asynchronous computer commercially available. It progresses from one operation to another without the time lag that occurs in all clock-fimed systems... processes more work in any given period. Asynchronous operation also permits updating or expanding the system at any time, without changing design or disrupting existing programs. Get the full story on the Philco 2000... first in fully-transistorized data processing... and the only asynchronous system available to business.



PHILCO 2000 Data Processing System

**PHILCO**  
*Famous for Quality the World Over*

COMPUTER DIVISION, GOVERNMENT AND INDUSTRIAL GROUP • 4700 WISSAHICKON AVENUE, PHILADELPHIA 44, PENNSYLVANIA

# COMPUTERS and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

Volume 9  
Number 2

FEBRUARY, 1960

Established  
September 1951

EDMUND C. BERKELEY *Editor*  
H. JEFFERSON MILLS, JR. *Assistant Editor*  
NEIL D. MACDONALD *Assistant Editor*  
MOSES M. BERLIN *Assistant Editor*  
PATRICK J. MCGOVERN *Assistant Editor*

SERVICE AND SALES DIRECTOR  
MILTON L. KAYE MURRAY Hill 2-4194  
535 Fifth Ave. New York 17, N.Y.

CONTRIBUTING EDITORS  
ANDREW D. BOOTH NED CHAPIN  
JOHN W. CARR, III ALSTON S. HOUSEHOLDER

ADVISORY COMMITTEE  
MORTON M. ASTRAHAN HOWARD T. ENGSTROM  
GEORGE E. FORSYTHE RICHARD W. HAMMING  
ALSTON S. HOUSEHOLDER HERBERT F. MITCHELL, JR.  
SAMUEL B. WILLIAMS

ADVERTISING REPRESENTATIVES  
Middle Atlantic States MILTON L. KAYE  
535 Fifth Ave. New York 17, N.Y.  
MURRAY Hill 2-4194

Washington 6, D.C. ROBERT CADEL  
1519 Connecticut Ave. Columbia 5-9727  
San Francisco 5 A. S. BABCOCK  
605 Market St. YUkon 2-3954  
Los Angeles 5 W. F. GREEN  
439 S. Western Ave. DUNKIRK 7-8135  
Elsewhere THE PUBLISHER  
Berkeley Enterprises, Inc.  
815 Washington St., Newtonville 60, Mass.  
DECATUR 2-5453 or 2-3928

COMPUTERS and AUTOMATION is published monthly at 815 Washington St., Newtonville 60, Mass., by Berkeley Enterprises, Inc. Printed in U.S.A.

SUBSCRIPTION RATES: (United States) \$5.50 for 1 year, \$10.50 for 2 years; (Canada) \$6.00 for 1 year, \$11.50 for 2 years; (Foreign) \$6.50 for 1 year, \$12.50 for 2 years. Address all Editorial and Subscription Mail to Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass.

ENTERED AS SECOND CLASS MATTER at the Post Office at Boston, Mass.

POSTMASTER: Please send all Forms 3579 to Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass.

Copyright, 1960, by Berkeley Enterprises, Inc.

CHANGE OF ADDRESS: If your address changes, please send us both your new address and your old address (as it appears on the magazine address imprint), and allow three weeks for the change to be made.

## Vol. 9, No. 2 B

News of Computers and Data Processors:

### ACROSS THE EDITOR'S DESK

... inserted between pages 16 and 17

#### FRONT COVER

New High-Speed Magnetic Tape Drive—Minneapolis-Honeywell

#### ARTICLES

Medical Diagnosis by Computer: Recent Efforts, and Outlook, S. G. VANDENBERG  
Buy, Lease, Share a Computer—Or Utilize a Service Bureau?, C. G. ABBOTT

#### FOR BETTER EDUCATION

The Working Group for Better Education  
Communicating, JOHN SALERNO  
Methods of Learning, LOUISE G. PETERSON  
Human Development, JOHN R. SMITH  
Mathematics, DONALD R. BROWN  
What Can the Working Group Do?, E. C. BERKELEY  
Announcement  
Verifying the Quality of Education Produced, DONALD TRUITT

#### READERS' AND EDITOR'S FORUM

Announcement: Issues of Computers and Automation  
Power Network Administration  
Concordances  
Computer Journal n + 1  
Calendar of Coming Events

#### REFERENCE INFORMATION

Survey of Commercial Computers, Part 2, NEIL MACDONALD  
A Survey of European Digital Computers, Part 1, J. L. F. DE KERF  
Survey of Recent Articles, M. M. BERLIN  
New Patents, R. R. SLOTNICK

#### INDEX OF NOTICES

Advertising Index  
Back Copies  
Manuscripts  
Reference and Survey Information  
Who's Who Entry Form

see January, page  
see January, page  
see January, page  
see August, page



Another way RCA  
serves business  
through  
electronics

## Solve sorting bottlenecks with an RCA 501

*Up to 40% of your data processing dollar can be consumed in sorting. Now, RCA offers a major breakthrough in sorting economy!*

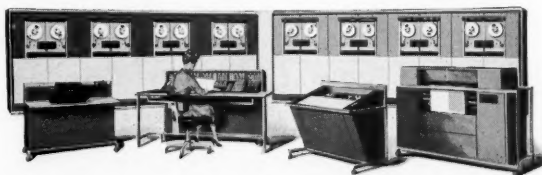
In speed, efficiency and low cost per item sorted, the RCA 501 System is indeed impressive! Tape limited sorting operations are greatly accelerated by the unique combination of 501 features.

The RCA 501 can *read and write simultaneously* on tape. To make this possible, *dual buffers*—a pair for input and a pair for output—are an integral feature of the system. Furthermore, the 501 can *read backward* avoiding time lost in rewinding.

Powerful features built into the tape system result in extremely compact information recording (saving miles of tape and hours of sorting time). *True Variable Length Recording* reads and writes items in their natural length rather than in artificial fixed word and block lengths. 501 Tape Units use an exceptionally short gap between items and require only 3.5 milliseconds to achieve full operating speed.

Superior sorting capabilities in the 501 are backed up by important reliability features. Positive accuracy is afforded by *Dual Recording* on tapes. All information is recorded in duplicate and both of the side-by-side recordings have individual parity checks. If either character is faulty, the correct one is automatically used without tape reread.

The sorting performance of the RCA 501 System is a fact of operating experience—not theory or conjecture. For full information write to—



**RADIO CORPORATION of AMERICA**  
**Electronic Data Processing Division**

CAMDEN 2, NEW JERSEY

# Readers' and Editor's Forum

## ANNOUNCEMENT

Beginning this month, *Computers and Automation* plans to publish a dozen "additional" issues a year. These issues will be devoted mainly to news of computers and data processing that flows "across the editor's desk." The "additional" issues will be prepared for printing two weeks after the printer's deadline for the regular issue; but will for the present be inserted in the regular issue. See insert in this issue between pages 16 and 17.

## FRONT COVER: NEW HIGH-SPEED MAGNETIC TAPE DRIVE

The front cover shows a new high-speed magnetic tape drive. It was displayed for the first time by the Datamatic Division of Minneapolis-Honeywell at the Eastern Joint Computer Conference (Dec. 1-3) in Boston. The drive is capable of reading or recording 96,000 decimal digits per second, and is one of the most efficient tape-handling systems yet devised. It uses an all-vacuum driving principle rather than a mechanical driving principle. This is expected to almost eliminate damage to magnetic tapes and substantially increase the efficiency with which they are handled. The new drive is expected to increase the life-expectancy of magnetic tapes several times, thus assuring the permanence of records that have been recorded in machine language on them. It will be used with the new Honeywell 800 computer being produced at Datamatic's two Boston area plants for delivery to customers beginning in October, 1960.

## POWER NETWORK ADMINISTRATION

Using an IBM 650 Data Processing Machine, Bonneville Power Administration is able to calculate electrical losses due to resistance factors in its widespread power system more accurately than has been possible before. Previously, electrical utilities used analog computers called network analyzers to calculate expected dissipation over their distribution lines. With a system as large as the one operated by Bonneville, the network analyzer could not keep track of any losses smaller than one million dollars per year. By applying the 650 computer, projected resistance losses can be calculated as closely as \$100 per year. With this increased calculating capacity, Bonneville can more closely relate the operations of its generating equipment to the needs of its customers. Similar improvements will result in power line construction in the future. Savings resulting from the digital computer program will run easily into millions of dollars per year.

## CONCORDANCES

The Pontifical Faculty of Philosophy, in Gallarate, near Milan, Italy, and computer engineers of IBM World Trade Corporation, are combining their efforts

to index statistically many of the world's great works of literature and philosophy. Compilations of these works in various alphabetical and statistical arrangements, including for example concordances, are prepared on an IBM 705. The first task to be tackled was a concordance of the monumental works of Saint Thomas Aquinas. Next was the Dead Sea Scrolls. One of the striking accomplishments of the computer has been to supply the most probable sequences of words to fill gaps in ancient, worn, incomplete manuscripts.

## COMPUTER JOURNAL $n + 1$

I. From the editorial "A New Philosophy" in "The Librascope Technical Review," vol. 1, no. 1, Fall, 1959, published by Librascope, Inc., Glendale, Calif.

"The tremendous growth of scientific and technical knowledge in the past two decades has led to substantial advances in virtually every field of technological endeavor. In the computer field alone, the avalanche of new ideas and techniques has been overwhelming even to those most intimately concerned.

"How to keep abreast of these developments is a matter of vital importance to a broad segment of industry and the military, for prompt utilization of state-of-the-art advances can provide the user with significant economic and strategic advantages.

"The problem is essentially one of communication, of disseminating, information to the proper audience in time to be of value.

"Librascope, Inc., has been active in the computer field for more than 20 years, and its programs over that period have embraced every phase of computer technology. We believe that portions of our work are of sufficient interest and importance to warrant presentation to a rather sizeable technically oriented audience.

"The Librascope Technical Review, which makes its debut with this issue, is being published to keep its readers informed on noteworthy research, development, design, and production activities of Librascope, particularly as they apply to the computer field.

## II. Titles of some articles in this issue:

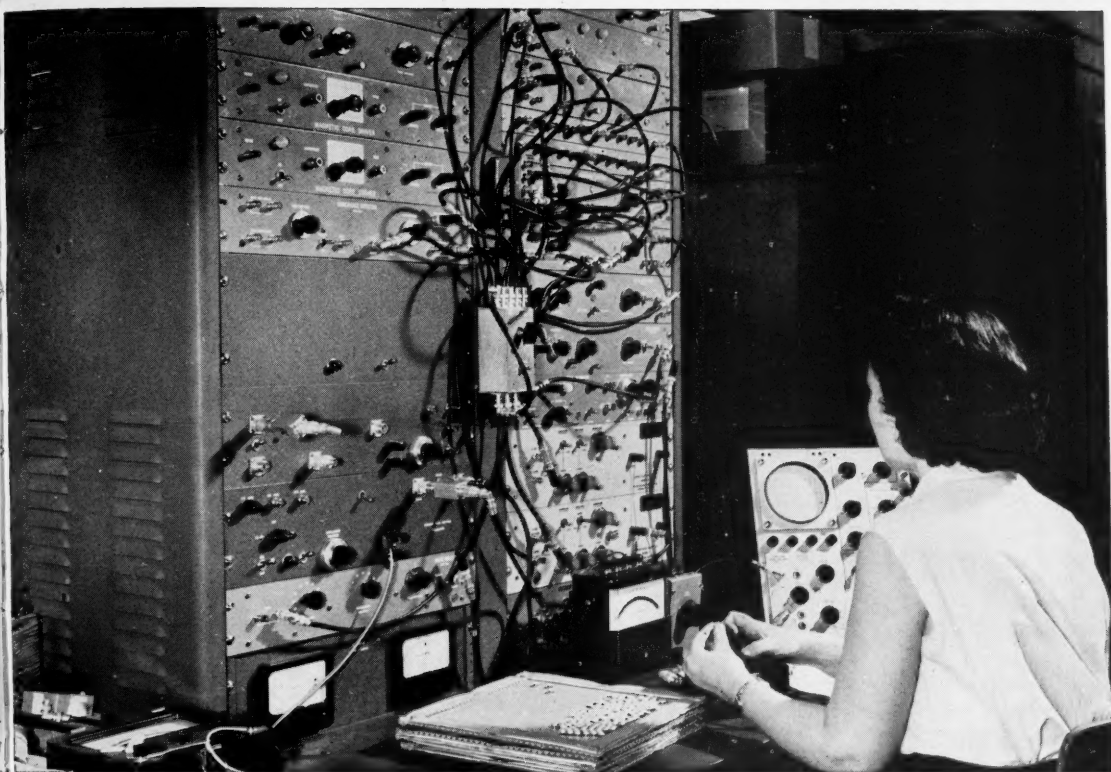
A Computer Joins the Flight Crew  
Computerizing the Process Industry  
Computer-Planned Vacationland  
Digital Evaluation of Analog Systems  
Computer Reliability

## III. From the Editor of *Computers and Automation*:

1. How does an ordinary human being, even if he is a trained computer engineer, keep up with the overwhelming wave of information about computers?
2. Are the purposes of communication served by establishing still another computer journal?
3. Is there a sensible, organized way in which the magazines in the computer field could work together to improve the communication of computer ideas?

Your editor is puzzled, and wonders if the readers of *Computers and Automation* have any suggestions.

Writ  
T  
"TAR  
FOR  
Includes  
properties  
Bobbin C  
.....  
"ARNO  
Contains  
including  
Silicon  
cores, M  
and speci  
AT



## PROVING GROUND for COMPUTER CORES

*Write for these  
Technical Booklets*

### Bulletin TC-108A

#### "TAPE-WOUND BOBBIN CORES FOR COMPUTER APPLICATIONS"

Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

### Bulletin GC-106C

#### "ARNOLD MAGNETIC MATERIALS"

Contains data on the complete Arnold line, including cast and sintered Alnico magnets, Sillectron cores, tape-wound cores, bobbin cores, Mo-Permalloy and iron powder cores, and special permanent magnet materials.

ADDRESS DEPT. CA-02

Take the hundreds of tiny Arnold tape wound bobbin cores that are the heart of some of today's remarkable computing machines. We produce them in a wide range of sizes, tape thicknesses, widths and number of wraps. Magnetic materials usually employed are Delta-max and Permalloy, in standard gauges of 1, 1/2, 1/4 and 1/8 mil, in widths from 1/32" through 1/4".

Each one must provide reliable, uniform performance. Each must meet rigid standards of magnetic and physical specifications, and the basic material properties must be examined for proper grading of cores to assure performance of the final product.

Only precision manufacture can assure you this top-quality performance. At Arnold *each* core is made and painstakingly checked before shipment by

the latest, most thorough methods and equipment.

Some of this testing equipment and many of our production methods were developed by us—for our own use exclusively—and surpass the standards set by the industry. You *know*, when you use Arnold cores, that the materials you receive have met all the rigid standard tolerances, plus any special requirements you may have. *All Arnold products are precision-made, precision-tested, to your specifications.*

Let us supply your requirements for bobbin cores—or other tape wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. • For more information, address *The Arnold Engineering Company, Main Office and Plant, Marengo, Ill.*

7047 B



# ARNOLD

**SPECIALISTS in MAGNETIC MATERIALS**

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES  
Find them FAST in the YELLOW PAGES

# FOR BETTER EDUCATION

## THE WORKING GROUP FOR BETTER EDUCATION

In the April 1958 issue of *Computers and Automation* we published an announcement of the formation of the Working Group for Better Education. We called upon members of the Association for Computing Machinery and/or readers of *Computers and Automation* to become concerned with the quality of education in elementary and secondary schools and to become active.

We said that "The quality of education in elementary and secondary schools is one of the most important factors bearing on the training of young people for doing good work in mathematics, science and computing machinery." We remarked that: "With 30 to 50 percent of young people entering college who cannot read adequately for college work, our concern must reach beyond the territory of just mathematics, science, and automatic computers in the junior and senior years of high school."

This announcement has now been published in the *Communications of the ACM* and a second time in *Computers and Automation* (in July 1958) and has been sent out in a mailing to the members of the Association for Computing Machinery (in December, 1958). Replies have been flowing back, and over 190 people are now in the Working Group for Better Education.

A list of the names and addresses of these people is being distributed to everyone in the group, to enable them to communicate with each other in local areas. In March a meeting of the Working Group for Better Education will be called in the Boston or New York area.

If you are a reader of *Computers and Automation* and/or a member of the Association for Computing Machinery, and are interested in this subject, please send us your name, filling in the reply form in an adjacent column.

We publish below some of the discussion which we have received. More discussion is invited.

### COMMUNICATING

John Salerno

Fort Monmouth, N. J.

I share your concern with the quality of secondary education.

Secondary education is of course important to the training of young people in mathematics, science, and

computing machinery. It is equally important, as you imply, to the training of young people for work almost everywhere else. We must keep in mind the fact that the computer arts and sciences are not only fields in their own right but also integral parts, present and future, of almost every other field.

Some of the frequently encountered products of the secondary—and even college—curricula make one despair of our school systems. Yet it is idle to blame schools of thought, pay scales, parent-teacher-student relationships, teacher training, or anything else unless we take constructive action. I have already suggested action that could be taken by the Association for Computing Machinery, but your proposal for a working group supplements my suggestions and gives hope for achievements below the college level I had in mind.

Of all the deficiencies in students and graduates, possibly the most deplorable is that in English and communication skill. My personal feeling here is that if this condition were corrected, our problems would be reduced materially. One thing is certain—to me, at least. Unless our young people learn to read, write, and communicate, it is a waste of time to attempt corrective action in other ways.

I have succeeded, I hope, in impressing upon my teenage daughter the overwhelming importance of being able to read, write, and communicate intelligibly. But how can this be accomplished in general? Shall we yield to the latinists, who almost have a point, or to the anti-latinists, who have no substitute? Are too many English teachers poorly qualified? Are parental attitudes serious stumbling blocks? The problem is clearly a complex one, and there are no easy answers.

I do not wish to give the impression that effective training in English usage would solve or eliminate the problem. I do however maintain that the present situation in this area is a rotten keystone in the structure.

Please include me in your roster of interested members.

### METHODS OF LEARNING

Louise G. Peterson

Brookline, Mass.

Along with the importance of having higher standards and WELL-QUALIFIED teachers in our schools, there is need for a more concentrated effort in studying methods of learning. To progress in accumulating and mastering more knowledge, we must find better ways of using our mental faculties.



## HUMAN DEVELOPMENT

John R. Smith

Newport Beach, Calif.

I am interested in better education and its relation to automatic computers. Please include me in your working group and put me on the mailing list.

I too am interested in the quality of secondary school education, agreeing that many young people cannot read adequately for college work. Also, many engineers and mathematicians can neither read nor write sufficiently well so that they can communicate with other members of our profession. However I would resist efforts to improve the level of education in any sense so restricted as to disregard human development in favor of technical development. I see my role in the working group as that of a counter weight, inasmuch as the computing world is now well populated with "computer nuts" and incoherent mathematicians.

Please do not take my comments as indication of lack of constructiveness. Critical or even reactionary appraisals of interim decisions often lead to final outputs of optimum quality.

## MATHEMATICS

Donald R. Brown

Honolulu, Hawaii

We are in Honolulu instead of New England for one year. Switching our children to different schools has highlighted educational problems. I am most interested in what mathematics kids should be taught.

## WHAT CAN THE WORKING GROUP DO?

Edmund C. Berkeley

Chairman, ACM Secondary Education Committee  
Newtonville 60, Mass.

Many people have asked us:

What can you do?

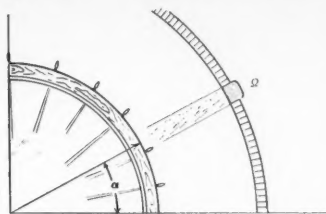
The answer to this question as I see it is this:

Two hundred people working together can do a number of things. We can inform ourselves. We can exchange our sources of information and references. We can draw each other's attention to situations and difficulties that should be known. Groups of us can make studies and put out reports of findings. We can disseminate knowledge. We may be able to be of special help in some local communities. We can publicize examples of success. In organization there is strength.

The educational situation in the United States is extraordinary in many ways. (1) There are 28,000 school systems, each of them under a different, independent control. Yet there is no objective measure of the education they produce. Why not? (2) There are at least half a dozen conflicting educational philosophies, some of them clearly expressed, some of them of such a nature that they will never be expressed and defended publicly, real though they are in terms of human behavior. How do you reconcile them? (3) Teaching machines, a vast application of information-handling machinery, are at hand. What do we as computer people advise in regard to them? (4) In cases where a local school system is so bad that our own children and most of their friends in the neighborhood cannot read adequately at ages 10 or 11, what can we do SOON ENOUGH so that it will make a difference?

These and other questions will be discussed at the first meeting of the Working Group, which will be

called for Saturday March 26, 10:00 a.m. to 12:00 p.m. in Cambridge, Mass. Notices will be sent out.



## ANNOUNCEMENT Re

### Working Group for Better Education

To: All members of the Association for Computing Machinery.

All readers of *Computers and Automation* who do not happen to be members of the Association for Computing Machinery.

From: Edmund C. Berkeley, 815 Washington St., Newtonville 60, Mass.

The quality of education in elementary and secondary schools is one of the most important factors bearing on the training of young people for doing good work in mathematics, science, and computing machinery.

As Chairman of the ACM Secondary Education Committee, I am eager to discover all of you who are interested in and concerned about the quality of education in reading, writing, arithmetic, mathematics, science, and related subjects—the quality of education actually being produced in the schools in your neighborhoods. With 30 to 50 percent of our young people entering college who cannot read adequately for college work, our concern must reach beyond the territory of just mathematics, science, and automatic computers, in the junior and senior years of high school.

We are forming a "Working Group for Better Education." We plan to put together and distribute a list of names and addresses of all persons interested in this field; to set up in this group close contact between all members; and to exchange information and discussion, and if feasible arrange local meetings.

If you are interested in being in the ( )ACM ( )C&A Working Group for Better Education, would you please return the following reply form or a copy of it?

If you have any remarks, comments, ideas, suggestions, etc., related to the subject of better education, I will be happy to receive them.

If you would like to work on any projects in this group, please tell me.

REPLY FORM (may be copied on any piece of paper)

To: Edmund C. Berkeley, Computers and Automation,  
815 Washington St., Newtonville 60, Mass.

I am interested in better education and its relation to automatic computers.

Please include me in the ( )ACM ( )C&A Working Group for Better Education, and put me on the mailing list.

Remarks .....

Name .....

Address .....

# VERIFYING THE QUALITY OF EDUCATION PRODUCED

Donald Truitt  
Nelleston, Conn.

## Verifying Quality

Verifying the quality of the product — on an absolute scale, not a relative scale — is a commonplace idea in American business today. When you buy a washing machine in the United States, you regularly buy it with a guarantee that it will work for a period of time, and American business does not regularly sell washing machines that do not work.

Verifying the quality of the product also exists in medicine, law, accounting, and many other professional fields. Examinations are set in these fields which effectively guarantee that those persons who pass such examinations possess knowledge up to a certain adequate level in those fields; and so these persons are licensed to practise their profession.

But the principle of verifying the quality of education produced — on an absolute scale, not a relative scale — seems to be missing from American schooling today. When a high school graduates a student with a diploma, nowadays no conclusions can be drawn as to what he knows or can do. The diploma does not necessarily imply that he can do anything up to a stated known standard. So we are buying the products of American schools without verifying the quality of education produced.

For example, many American parents and many American college professors are saying about great numbers of young people as they come out of high school "they can't read, they can't write, they can't spell, they can't do arithmetic." Other Americans, especially members of high school faculties and administrations, say "our young people are better taught, and more of them are better taught, than ever before in history." Are those statements true or not true? Nobody really knows.

No report exists, so far as I know, for any American school system that tells what percent of their young people who finish school in June actually can perform adequately on an absolute scale with regard to a dozen essential branches of knowledge expected to be taught in school. These include reading, English, mathematics, science, the ability to learn well, and a few more.

## Existing Measures of Education Produced

But you may say, "This is incredible. Surely a high school diploma means something. Surely teachers' grades mean something. Surely the standard tests supplied by recognized testing services mean something."

Yes, they all do mean something.

In former days, the diplomas from high school did mean achievement up to a certain standard. But heavy social pressure from the community, and from less able students and their parents, and from sympathetic teachers who did not want to give failure grades to even the poorest students in their last year in high school, has caused the diploma to be watered down and watered

down. Nowadays the diploma means in most cases only a certificate of satisfactory attendance and satisfactory conduct.

The grades given by a teacher to a student — often in the form of A for excellent work, B for good work, C for fair work, D for passing work, and F for failure — are also necessary and useful, in almost any course. But they are bound to be relative: no teacher can fail half of his class, no matter how little that group may know. In fact, nobody can seriously maintain that objective measurement of education produced is possible through teacher's grades.

The carefully worked out standard tests supplied by recognized testing services, have many advantages, and are necessary and useful in many ways. They permit quick and accurate relative positioning of students on scales of aptitude and achievement. They are objective, in the sense that different observers would arrive at the same scores. But the tests are confidential, so that they cannot be appraised or evaluated by open public discussion and argument. Also they are relative and not absolute, for they regularly give scores based on "national norms" expressed in grade level (a typical answer is "your son Johnny is at grade level 7.6 in reading"); the tests do not say whether or not your son Johnny is "literate," can read by himself whatever he needs or wants to read.

## Basic Levels of Basic Knowledge

Verifying the quality of education produced in schools is possible and is not difficult. We can recognize as basic knowledge: reading, writing, arithmetic, spelling, and half a dozen more subjects and skills like science and the ability to learn well. We can express a level of basic knowledge, whichever is higher of the following two standards:

- (1) The social minimum standard: the minimum level of knowledge expected to be attained by a useful, independent member of society in our culture. For example, a person is expected to be able to read and understand the directions on a bottle bought in a drugstore.
- (2) The 8th grade minimum standard: the level expected to be attained by an average 8th grader. For example, such a person is expected to be able to do a given multiplication correctly.

And we should be able to expect that a school system should, for as many students as possible, pull them through the basic levels of basic knowledge.

To promote discussion and argument, the basic terminology of knowledge can be public, the examinations can be public after they are given, the school's degree of success in pulling students through these basic levels can be public. People can then verify the quality of education produced in their schools.

### An Actual Trial of This Idea

Some friends of mine and I were actually able to try out this plan in the area of arithmetic, at the end of 1957, for some 367 students in Grades 8 to 12 in the school system at Hillsdale, Pa. We put together 34 simple, direct questions in arithmetic (copy of the paper is available on request), and told the students to take as much time as they wanted to work the paper.

The results were shocking. Seventy percent of the students had 6 or more wrong answers out of the 34 simple questions; and this under conditions where they had been told they could ask for more time and "go back and check your work." The "times spent" ranged from 15 minutes to 45 minutes; many of them by putting in just a few more minutes could have done much better. More than half could not multiply 569.43 by 8.79 correctly. More than half could not put down the right answer when asked to write "three millionths" or "two and a half thousandths" in figures. About 70 percent of the students were unable to change 18,000 miles an hour into 5 miles a second (this was asked when the first Sputnik was very much in the news). Yet there was plenty of evidence in their papers that they had "tried."

The great big factors producing the poor results were very plainly shown by the 367 answer papers we received and studied:

- (1) Lack of discipline in studying — lack of consistent attention, as if half the student's mind was on his work and the other half was on something else; lack of training to go back and check his work; and
- (2) Spotty learning — topics missed and never made up; topics partly learned and never fully learned; topics once learned and later forgotten.

Two thirds of the students that we found in Grade 8 to Grade 12 apparently "can't do arithmetic," not because they don't have the mental ability, but because they have not learned how to study hard and how to work carefully.

And the unhappy facts are thoroughly concealed because of the absence of public, objective, absolute measures of basic education actually produced by schools. People do not have school system reports that tell them the actual quality of education produced. So people can't verify the quality, and do something about improving the quality, year after year.

## CALENDAR OF COMING EVENTS

Feb. 1-4, 1960: 1st ISA Instrument-Automation Conference and Exhibit of 1960, Rice Hotel and Sam Houston Coliseum, Houston, Tex.

Feb. 2-5, 1960: National Symposium on Machine Translation, University of Calif., Los Angeles, Calif.

Feb. 25-26, 1960: Univac Users Association Semi-Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

March 21-24, 1960: IRE National Convention, Coliseum and Waldorf Astoria Hotel, New York, N.Y.

March 24-25, 1960: 1960 Northeastern Divisional Data Processing and Computer Conference and Business Show, sponsored by the National Machine Accountants Association, Statler-Hilton Hotel, New York, N.Y.

March 26, 1960: Fourth Annual Symposium on Recent Advances in Programming Methods, conducted by the Central Ohio Association for Computing Machinery, Ohio State University, Columbus, Ohio.

April 7-8, 1960: Annual Joint West Coast Regional Meeting of the Institute of Management Sciences and the Operations Research Society of America, U.S. Naval Postgraduate School, Monterey, Calif.

April 14-16, 1960: Symposium on Basic Questions in the Structure of Languages, sponsored by American Mathematical Society and Association for Symbolic Logic, Hotel New Yorker, New York, N.Y.

April 18-19, 1960: Third Annual Conference on Automatic Techniques, Cleveland-Sheraton Hotel, Cleveland, Ohio.

April 20-22, 1960: 12th Annual Southwestern I.R.E. Conference and Electronics Show including the National Medical Electronics Conference, Shamrock-Hilton Hotel, Houston, Tex.

May 2-6, 1960: Western Joint Computer Conference, San Francisco, Calif.

May 9-12, 1960: 2nd ISA Instrument-Automation Conference and Exhibit of 1960, Civic Auditorium and Brooks Hall, San Francisco, Calif.

May 17-18, 1960: Symposium on Superconductive Techniques for Computing Systems, sponsored by Information Systems Branch, Office of Naval Research, at Dept. of Interior Auditorium, Washington, D.C.

May 23-25, 1960: 9th Annual Telemetering Conference (West Coast), sponsored by ISA with ARS, AIEE and ISA cooperating, Miramar Hotel, Santa Barbara, Calif.

June 1-3, 1960: 6th Annual ISA Instrumental Methods of Analysis Symposium, Montreal, Canada

June 6-7, 1960: Second Conference of The Computing and Data Processing Society of Canada, University of Toronto.

June 22-24, 1960: 1960 National Conference and Business Show, National Machine Accountants Association, Mark Hopkins and Fairmont Hotels, and Calif. Masonic Memorial Temple, San Francisco, Calif.

June 25 - July 5, 1960: 1st International Congress for Automatic Control, AACC sponsored, with ISA, ASME, IRE and AICE cooperating, Moscow, U.S.S.R.

August 23-25, 1960: Annual Meeting of the Association for Computing Machinery, Marquette Univ., Milwaukee, Wisc.

Sept. 26-30, 1960: 3rd ISA Instrument-Automation Conference and Exhibit of 1960, and ISA's 15th Annual Meeting, New York Coliseum, New York, N.Y.

Nov. 2, 1960: 13th Annual Conference on Electronic Techniques in Medicine & Biology, sponsored by ISA, with IRE and AIEE cooperating, Washington, D.C.

# Medical Diagnosis by Computer: Recent Efforts, and Outlook

Steven G. Vandenberg

Mental Health Research Institute  
Univ. of Michigan  
Ann Arbor, Mich.

(Based on a paper presented at a symposium "The Impact of Computers on Psychological Research" at the American Psychological Association Meeting, Cincinnati, Sept. 7, 1959)

Electronic computers are being used all over the country for business and scientific computations—including many social science computations; yet there are still relatively few non-computational applications of computers, such as in military inventory control, airplane ticket reservations, and in banking. The remaining projects consist mainly of small-scale demonstrations or feasibility studies of problem solving, learning, pattern perception, foreign language translation, information retrieval, medical diagnosis, etc.

My subject will be limited to the role of computers in medical diagnosis. There has been enough interest in this area to have led to a conference on diagnostic data processing at the Rockefeller Institute for Medical Research.<sup>9</sup> Also, various papers on related topics have been presented in the last year or so at several computer conferences. The Russian Soviet Fleet Newspaper carried a story about a diagnostic computer according to a recent AP release.

Rather than present a complete account or annotated list of references of the work done in Russia, France, England, the Netherlands, and the USA, let us take a minute or two to look at the categories and a few examples.

Three species can be distinguished; and if one looks closely, it seems that all their possible hybrids are forthcoming.

We might name the three main types *simulation*, *statistical analysis*, and *logical diagnosis*.

## Simulation

Simulation is being used for instance in vectorspatial electrocardiography<sup>4</sup> and in neurophysiology. A—usually greatly simplified—model of the symptom under study is programmed for a digital computer or, more often, the proper electrical circuits are built into an analog computer and the behavior of this model is observed continuously or at certain critical moments.

Most of the phenomena of interest to psychologists are very complex and have so far not been attacked with computers. Exceptions are learning, pattern perception, and problem solving.

## Statistical Analysis

Examples of the statistical work are the auto-correlational and cross-correlational analysis of EEG and polygraph records for which Dr. Ax of the Lafayette Clinic in Detroit is getting ready. In the Schizophrenic

Project of the University of Michigan and the Ypsilanti State Hospital, we are correlating a large number of biochemical, physiological, and psychological variables with the ward behavior, social history, and psychiatric interview items of schizophrenic and other patients who are brought into our research ward for a nine-week period. Without the aid of computers, the cost of such large-scale statistical analyses would be prohibitive. There is wide use of computers for this type of work; so I will not say much about this, except to call attention to "Computers in Behavioral Science," a new department of the quarterly "Behavioral Science," which is publishing among other things abstracts of statistical programs for all types of computers.

## Logical Diagnosis

The third type of computer analysis, the logical analysis of diagnosis, is perhaps the most exciting. A paper by Ledley and Lusted in a recent issue of Science gives a comprehensive description of the ways in which symbolic, logic, probability theory, and value theory can be used to formalize the diagnostic process sufficiently so that a computer program can be written to go through this process step by step. If enough knowledge exists about a particular area, an incidence-of-symptoms table somewhat like a logical truth table may be constructed. Diseases and symptoms define the rows and columns, and zeroes, question marks, and ones in the cells represent the presence or absence of each symptom in the various diseases. Refinements can be introduced by using the probability of the occurrence of each symptom in each disease, as well as by considering how far the presence of the several symptoms may be regarded as contributing information which is independent both logically and statistically. Next, the likelihood of various diseases can be dealt with by considering the subject's age, sex, previous history, exposure to specific climatic or occupational conditions such as stay in the tropics, radiation, harmful metals as well as hereditary diseases in blood relatives, the season of the year, and the location of the diagnostic center.

When finally a decision is to be made regarding treatment, the paper by Ledley and Lusted shows how von Neumann's theory of games may be used to determine the optimum strategy in the "game" between physician and nature, provided that the positive and negative values attached to the various "pay-offs"—representing the values associated with the expected outcomes of the



acceptance or rejection of the various treatments — have been decided upon. These values are usually based on highly personal decisions of the physician, or of the physician in consultation with the patient or relatives of the patient, but may sometimes be regulated by religious ethics or by military code.

The more advanced and precise the knowledge in the particular area, the easier it is to construct the table of diseases and symptoms. Of course, in the ideal situation where there exists a complete one-to-one relationship between diagnostic test, symptoms, and disease, a computer program is hardly necessary unless computer time becomes cheaper than the time of human clerks. It is particularly when the relationships are more complex that aid from computers may be valuable, provided that every relationship can be spelled out clearly.

### Diagnosis of Mental Diseases

It is unfortunately true that in the diagnosis of mental diseases there exists as yet no such orderly system of clearly understood relationships. Attempts to develop a more explicit system are under way. The search for objective diagnostic tests as well as the construction of the various psychiatric rating scales constitute important steps in this direction. The more factual the items in these rating scales, the more interesting it will be to correlate such items with various diagnostic tests. It may well be that the psychiatric categories are too heterogeneous, and that the choice of treatment and prognosis will have to be based on new and finer groupings of patients arising out of the constant amassing and cross-correlation of vast masses of data. Before this can be done effectively, there will have to be much more uniformity in the way in which history and mental status information is obtained, recorded, and stored. It seems not unlikely that some mental hospitals will acquire punch card systems which would allow routine periodic analyses of such data. Nor does it seem unlikely that a number of such hospitals may develop a common system so that the problem of small samples could be avoided.

Whether or not the adoption of such common systems of detailed punched card records will lead in time to the use of computers on anything like a routine basis is uncertain. Psychiatric diagnosis by computer cannot be developed without going through this more prosaic step. At any rate, it seems fairly certain that diagnosis with the aid of a computer can be far easier worked out for various medical specialties other than psychiatry — even though its potential contribution might be greater there — because uniformity of diagnostic procedures will be so much more difficult to achieve. Curiously enough, many of the engineering problems one would encounter in constructing a large scale diagnostic computer are being solved, so that it is possible to think of developments on a par with the most imaginative science fiction stories. The time may come when a network of computers is tied in with various record-keeping agencies such as the Bureau of the Census, hospitals, social service bureaus, income tax bureaus, police departments, insurance companies, banks, schools, and military and civilian employers to keep cumulative records for every person on their rolls. Such records can be displayed on picture tubes and photographed at enormous speeds.

Similarly documents can be read at increasing speeds. Direct verbal communication with computers is being developed so that soon for certain purposes one can converse with the computer without a human intermediary punching tapes, cards, or buttons.

### Direct Communication with a Computer

There is a certain fascination about speculation what the psychological effect of such arrangements might be. In the case of direct communication with the computer the already present tendency to personify the equipment will undoubtedly grow; it will often be forgotten that the "behavior" of the machine has been planned in every detail by a staff of programmers and executive policy makers.

While direct communication with the computer may lead to unpleasant psychological attitudes and feelings, it should be remembered that such use of computers would at least be known to the individuals communicating with the machine. It is much more likely, actually, that there will be a good deal of secret, non-public or at least not widely known uses of computers without the direct cooperation or knowledge of the individual about whom facts are being processed.

### Legal and Political Aspects

There are some very interesting legal and political battles ahead of us when decisions will have to be made about the availability of records for such purposes. The question who may have access to the various types of records will come up many times before clear-cut policies can be worked out. Some of the problems concerning the use of wire-tapping, lie detectors, and the rights of privileged communication will provide legal analogies and precedents. The risk of increased regimentation and red tape will be great, perhaps great enough to offset any gain in efficiency and knowledge which might be won.

Perhaps it might be possible to limit such systems to inclusion of only those persons who wish so and who are likely to benefit clearly from them, giving each and everyone a choice in the matter. Insurance companies might move in this direction. Larger business concerns might develop such systems for employees willing to cooperate. Many safeguards will have to be developed to prevent the occasional injustice through inaccuracies. Already we have read in the newspapers about a woman who was kept imprisoned for some time because of an error made by punched card equipment or operator.

### Errors of Judgment

I for one believe that at least as many errors of judgment as well as errors due to inaccuracies are made today by the innumerable human records keepers and officials as would be made by a computerized system. At least errors of judgment might be minimized there and the element of personal bias eliminated. It may be a matter of taste whether it is more annoying to be unfairly treated by a machine or by a human being. Of course, it may be that for political, economical, and psychological reasons it will be advantageous to keep on employing human intermediaries so that the public never deals directly with the computer. Clerks could pass information to the computer by teletypewriters and infor-

mation could come back to them to be given out in the clerk's own words and voice.

### Attitudes Towards Computers

Perhaps fears of unfavorable attitudes are unwarranted. In the world of tomorrow, everyone may be sufficiently exposed to certain types of electronic devices in his office or factory, in the library or in his military service so that more indifferent or even favorable attitudes may develop.

One thing is certain: there is a need for studies on the attitudes towards computers. Already there have been many cartoons and jokes about computers. While they would not form a representative sample they might define the range of attitudes. The treatment of computers in science fiction stories could form another source of opinions and feelings. Such more or less "literary" analysis should be supplemented by data from polls and from experiments in which the effects of education and pertinent information on the attitudes toward computers can be assessed.

It is likely that differences will be found between the attitudes of those who might imagine themselves someday to be personally involved either as potential "case on record" in such a system or as users or as operators of such a system, and those who see such events as less likely to concern themselves directly. Nevertheless the information from such studies would not only be of considerable interest in itself, but it could serve to guide the development of increased use of computers in the public domain for social, medical, and other personal benefits to mankind.

### Accumulation of Data for Psychiatric Diagnosis

After this look into the near future I would like to return to the present and consider a few more suggestions for research. Whether or not computers will ever be used to help in psychiatric diagnosis, it will be of enormous value if we could accumulate the kind of information which would be necessary for such a system. The kind of information needed would far exceed what currently is being collected by the Federal Government, or by any state. The information should include the incidence of a number of details about history and present mental status and their interrelationships as well as their correlations with clinical tests, treatment results, etc. Studies by Morton Kramer and Hyman Goldstein of the Biometrics Branch of the National Institute of Mental Health indicate that some of these relationships may be quite complex.

### Diagnostic Manual

Next, it would be necessary to write out in detail a diagnostic manual, which would permit the construction of a complete logical tree such as would be needed to construct the computer program. While one may hope that the data used would be gradually limited to objective measures and factual items, there is no reason why they could not include intuitive judgments of ego-strength, paranoia, or flatness of affect, provided such items are described in enough detail to assure a certain degree of uniformity in the judgments.

The human diagnostician might be a part of the system. He could be asked to provide the eyes and the intuition which the machine would lack forever or at least for a

long time to come. Studies of this kind are urgently needed to bridge the gap between or rather to combine clinical and actuarial prediction.

The development and acceptance of computer-aided diagnosis in other areas could provide a great impetus to speed up the construction of such a system. But there is no need to wait for this uncertain event. In fact, a diagnostic manual a little bit like this has been constructed by D. H. Stott and Miss E. G. Sykes of the University of Bristol in England.

The Bristol Social Adjustment Guiders consist of a set of forms for the systematic recording of a child's behavior, and the records can be analyzed to provide diagnostic information and suggestions for treatment. Perhaps it will be possible to construct a manual which would eliminate the necessity of asking everyone the same questions. Once it is known that the subject is not married or an only child or paranoid, one could go to a certain section of the manual constructed for such cases and progressively narrow down the number of possibilities. There is a popular book which approached best seller status some years ago in which this method was applied. Since it was not based on statistical analyses it was not very adequate but the principle of asking only pertinent questions was present.

### Computer Diagnosis

Before closing, we should consider the question whether completely automatic diagnosis without human intermediaries will ever be possible. Clinicians will say: "No! A machine will never be able to develop empathy." The computer enthusiast will say: "but given enough instances, a heuristic program stored for such eventualities could develop, or learn a reasonable facsimile." It seems best to straddle the fence on this question.

### BIBLIOGRAPHY

1. Robert S. Ledley and Lee B. Lusted, Reasoning Foundations of Medical Diagnosis, Science, July 3, 1959, 130, 3366: 9-22.
2. F. Paycha, Memoire Diagnostique, Montpellier Med., 1955, 47: 588.
3. N. Burch, A. Silverman and T. H. Greiner, New Approach to Theory and Automatic Analysis of EEG, 1956, Proc. Soc. EEG and Clin. Neurophysiol., 8:157.
4. E. Simonson and O. H. Schmitt, Present Status of Vectorcardiography, 1955, AMA Arch. Int. Med., 96:574-590.
5. Harry Weinrauch and Albert W. Hetherington, Computers in Medicine and Biology, 1959, JAMA, 169:240-245.
6. D. W. Davies, Mechanization of Thought Processes, 1959, Nature, Vol. 163, No. 4656:225-226.
7. D. H. Stott, The Social Adjustment of Children, Manual to the Bristol Social Adjustment Guide, 1958, University of London Press.
8. Mental Health Statistics, Current reports, U.S. Department of Health, Education, and Welfare, Public Health Service, National Institute of Mental Health, Bethesda, Maryland.
9. Conference on Diagnostic Data Processing, January 10, 1959, Rockefeller Institute, New York.
10. L. Doyle, Programmed Interpretation of Text as a Basis for Information Retrieval Systems, a paper presented at the Western Joint Computer Conference, San Francisco, March 3-5, 1959.
11. Organizing a network of computers. 1959, Datamation-5, 2:3.
12. W. S. McCulloch in (6).
13. O. G. Selfridge in (6).
14. K. Brodman, AMA Archives of Internal Medicine, May 1959.

# Buy, Lease, Share a Computer— Or Utilize a Service Bureau?

Charles G. Abbott

Manager, Administrative Services Dept.

Arthur Andersen & Co.

New York, N.Y.

(Based on a talk given at the American Management Association Conference, March, 1959,  
New York, N.Y.)

In discussing the rent or buy issue, we have to assume that justification exists for ordering an electronic data processing machine and that what we will be really exploring are the economics of financing the installation in alternative ways. However, in the evaluation of off-premises machinery the number, type, frequency and size of the applications are important to an understanding of whether an efficient and profitable basis exists for contracting out the work. Seldom would you expect to find the repetitive accounting type of application sent to a computer service bureau; but it is common to contract for time when a company's program is highly oriented towards the analytical, scientific or operations research approach.

## Service Bureau

The management which commits itself primarily to the high-speed solution of problems in planning, scheduling, or other types of decision-making is confronted with an interesting paradox:

1. It will probably enjoy the greatest long-term benefits a computer can offer, but
2. It will probably be among the last to have a machine of its own.

The simple explanation is that these classes of problems are hard to define, and difficult to program in both the broad and the specific sense of the word. Yet typically they take relatively few machine hours to solve. Under these circumstances a computer could not be fully utilized during the many months or years required to build a library of proved routines from which come the answers to the bigger management questions. To those who give priority to programming the decision-making problems first, the service bureau is a natural ally.

Service bureau rates average \$325 to \$350 per utilized hour, for a scientific oriented computer, without operator and without off-line peripheral equipment. But if the company rents such a machine, the cost per utilized hour depends very much on the number of hours the machine is used; the cost drops in half if the machine is used twice as much. If the rental is \$25,000 a month, the break-even point figured by simple arithmetic is about 75 hours of use per month. The comparison assumes that the user will provide his own operators; it reflects only equipment rental; and there is no allowance for amortization of any starting costs. This comparison shows quite clearly the advantage of contracting work out, up to a certain point.

When the average workload equals about one-half a shift then it may be time to call the projects back home.

The breakpoint would vary between service bureaus, depending upon the type of machine used.

It is worth noting that **billable contract time is generally effective time**. The subscriber should not be expected to pay for time lost due to breakdown or for reruns occasioned by machine error or defective tapes.

Many clients of service facilities use them at irregular intervals but there is growing precedent for booking recurring production time. One of the larger and more competent EDP departments in commercial industry today has no machine of its own and probably will not until its high-level problem-solving generates computer time equal to the characteristic breakpoint.

## Shared Facility

Despite the apparent attractiveness of service bureau rates, there are practical difficulties attached to using one extensively. When it comes to pouring large doses of daily information into an electronic funnel, scheduling complications and lapses in communication are bound to occur. This was one of the considerations which led a group of New England insurance companies to syndicate and operate its own facility.

The Aetna (Fire) Insurance Company recognized in 1955 that the machine they could afford would not meet their needs and that the one they needed they could not afford. Even if an independent service center had existed in the immediate area, countless administrative problems would have stood in the way of efficient daily operation. Consequently they invited three other underwriters to join with them and form a data processing center known as SPAN—a contraction representing the four member companies. Subsequently the National merged with another concern and withdrew its workload, but not its financial support, pledged at the outset.

The concept of SPAN is certainly sound and makes considerable economic sense for a group with such a homogeneous product line. State regulatory agencies prescribe the form of financial data and consolidated rating boards influence the statistical output. Nevertheless, the parent organizations experienced difficulty resolving the final form and content of internal management reports but their common objective eventually brought about complete standardization of reports and agreement on uniform inputs. This accomplishment led logically to the potentially largest economy available in a shared operation—a common set of programs. The highly expensive task of analyzing and coding 45 basic runs cost each member exactly one-third of what it

might have. Up until the present time there has been no custom programming. Some companies do not receive all of the output but no one has asked for special processing.

### Shared Cost

The formula for defraying the cost of SPAN seems to be as workable as it is simple. The capital items are shared equally. Programming, at \$400,000, is the largest of these. Total site preparation follows at \$360,000 exclusive of leasing the land. This is a remarkable figure in view of the facilities at Hartford. They own a completely modern, air-conditioned, functional building with ample administrative quarters, spacious computer room, lounge, and accommodations for the eleven programmers. There is an enclosed truck-loading dock, receiving room, supply and storage space. Many installations have cost their single occupants as much as this and offered less.

Operating expenses, which are largely composed of equipment rental, are distributed ratably on a usage basis. Income derived from subleasing of time to outsiders is applied against operating expense and the balance billed. The corporation is essentially nonprofit so that the three stockholding members are billed in arrears for actual expenses. The backers of SPAN are saving from 40 to 85% of the operating costs each might have otherwise experienced with a proprietary machine.

### Operation

During 1958 the computer ran 1.2 shifts for the group and .5 shift for outsiders. The applications were all in the province of premium and loss accounting. January of 1959 marked the swing into agency accounting which will be converted to computer over a two-year period, eventually utilizing the second shift.

The pay-out will not be established with certainty until conversion is complete, but if it approximates predictions, operating expenses will be more than offset by the displaced costs within the offices of the member group, and by a margin that will quickly recover the preliminary expenditures.

A welcome advantage of the SPAN program is the tabulating service planned for the near future. It will take over those residual tasks which linger on and defer release of punched card equipment. One tabulator is being used 19 hours a month thereby diverting potential profits from the shift to electronics. The work will be transferred to the center.

### Ingredients of a Shared Facility

The ingredients of a cooperative program are clear:

- Similarity of product or service
- Strong backing at the Presidential level
- Firm resolution to adopt standardization
- Allotting the people to the project whom you can least spare
- Simple but binding agreement on the sharing of expense

There is no mystery to the formula. Therefore, *the idea should spread*, but in which direction? Presumably industries which have worked towards procedural standardization ought to be interested — the banks, the airlines, maybe the utilities or the retailers. General manufacturers, no matter how much they might desire the results, will unquestionably have the hardest time negotiating the essential common denominators. Incentive-pay plans all differ,

and most are frozen by contract. Some inventories are identified by part numbering schemes that relate to blueprints and therefore can't be changed. Accounts receivable have discount secrets locked up within them, and warrant special security measures. The fact remains that while some custom treatment could be tolerated under a share arrangement, much of the programming and most of the data keys have to be uniformly applied or else the participants will dissipate the profits inherent in this mode of operation.

### Rent or Buy?

To the majority who have lined up at the business machine manufacturer's door, the issue is not one of how to arrange part-shift terms for part-shift loads. The question is which of three options to exercise:

- Rent indefinitely,
- Purchase outright, or
- Rent for several years and then buy.

This is an investment decision in which the rate of return is largely influenced by the estimated savings of the applications, and, to a secondary extent, is improved by judicious selection of the best financing arrangement.

### Technical Obsolescence

The classic concern of the buyer has been obsolescence of his equipment by virtue of technological developments. In the past five years, computers have increased in speed, and in the capacity of fast access storage, by a power of ten. But there has been no apparent dissatisfaction with the outdated machines and no tendency to replace them in any substantial number. However, it is true that intervening developments have broadened the market and lowered the initiation fee. The late starters are unquestionably receiving more for their computing dollar.

The shift to transistors and other solid-state components was predicted some time ago, and now it has occurred. As we analyse their contribution we see improvement in installation and operating costs. But generally speaking, the rate of change in the productive characteristics of data processing systems has been leveling off.

Scientific advancement will not level off, but there are strong indications that developments will be concentrated on miniaturized components which will do more, for less. Take the field of storage elements. The researchers are talking of storing information in light sensitive chemical cells, at the intersections of wire grids woven somewhat like a screen, and in tiny loops of supercooled wire. The access to data will probably not be much faster but the costs and space requirements of these components could be significantly less.

Technical obsolescence of the central computer seems to be emerging as more of a theoretical proposition than a real one. There is a greater likelihood of obsolescing input/output mechanisms to the detriment of persons who have purchased such peripheral equipment. This possibility has influenced some to rent the attachments in order to benefit from periodic improvements in their performance characteristics.

### Financing

If we can conclude that technical obsolescence is not a real deterrent to buying, then we can explore the relative costs of financing the rental or the purchase of a system.



# COMPUTERS *and* AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

Volume 9  
Number 2B

FEBRUARY 2, 1960

Established  
September 1951

Published by Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass.

## News of Computers and Data Processors: "ACROSS THE EDITOR'S DESK"

### ANNOUNCEMENT

For some time we have wondered what to do about the great and increasing volume of currently important and interesting information about computers, data processing, and automation which flows across our desk, and for which there has been no room up till now in "Computers and Automation".

For example, a great many important announcements from many organizations can hardly be published at present, because until now there has been no space in "Computers and Automation" to publish them. To give them space would have meant not printing many important and worthwhile articles.

So we have decided to experiment with printing a dozen "additional" issues a year:

- The regular issues of "Computers and Automation" are assembled about the 1st of each month, and after printing by letterpress are given to the post office to mail out at the beginning of the fol-

lowing month. The new issues will be assembled about the 15th of each month, will be printed by photooffset, will be inserted in the regular issues, and mailed out at the same time.

- These new issues will be put together with less editing and filtering; they will be in the nature of "rush reports", so that you, our readers, will know more, faster.

- Instead of one month's delay at the minimum, there will be only two weeks delay at the minimum.

IF YOU HAVE AN IMPORTANT ANNOUNCEMENT or IMPORTANT NEWS, mail it to us to reach us by the 15th of each month--and we shall do our best to have it printed and in the mail to all readers of "Computers and Automation" by the beginning of the following month.

We hope in this way to be of still more service to the expanding computer field.

### COMPUTER MEMORY

#### BASED ON TINY MAGNETIC DEVICES, TWISTORS

Western Electric Co., 195 Broadway, New York 7, N.Y., and Bell Telephone Laboratories, 463 West St., New York 14, N.Y.

Computer technology has been significantly advanced by mass production of a new, accurate and fast electronic memory.

Hair-thin wires wrapped with magnetic metal tape in barber-pole fashion plus tiny bar magnets are the basic elements of the permanent electronic memory. It is comparatively inexpensive, easy to produce, and will help speed up computer developments. The memory will supply bits of information at

speeds in millionths of a second to a computer.

Only 14 months elapsed between the decision to use the memory and its readiness for mass production by automatic techniques. This was accomplished through closely coordinated research-engineering work.

A typical memory unit is built up of alternating grids of magnetic wire strands called "Twistors" and plastic cards with arrays of minute bar magnets.

The Twistor is a thin, hair-like copper wire, around which is spirally wrapped a magnetic tape 1/10 of the thickness of the wire itself. The magnet array is formed by bonding a thin sheet of magnetic material to a plastic card and then removing all undesired magnetic material by precise photoetching

methods. The finished card stores information in much the same way as a punched card in an office calculator or computer.

In a punched card, information is stored by the presence or absence of a hole. Similarly, the new Magnet-Twistor memory retains information by the presence or absence of a bar magnet at a specific location on the plastic card.

When a punched card is inserted into a calculator, an electric current flows where the card is punched and does not where there is no hole, providing information to the calculator. When a Magnet-Twistor memory card is read by a computer, an electric pulse is transmitted if there is no magnet or blocked if there is a magnet present.

#### TINY NEW "SPACE-AGE" ELECTRON DEVICE TO ADVANCE MISSILE CONTROL AND GUIDANCE

Radio Corp. of America, 30 Rockefeller Plaza, New York 20, N.Y.

A tiny new Space Age electron device, expected to perform important functions in missile control and guidance systems, as well as in the industrial and entertainment fields, was described in Montclair, N.J. on Jan. 13, by an engineer of the RCA Semiconductor and Materials Division.

Speaking before Northern New Jersey members of the Institute of Radio Engineers at the George Inness School, Dr. D. Jos. Donahue discussed the device, called a tunnel diode.

The unit, he said, is no bigger than the head of a match and holds tremendous promise for applications in missiles, satellites and ultra-high-speed data-processing systems. The device derives its name from the way in which electrons seem to "tunnel" through it with the speed of light.

The RCA Semiconductor and Materials Division, with headquarters at Somerville, is currently offering germanium tunnel diodes to the electronics industry for experimental purposes on a commercial sampling basis.

According to Dr. Donahue, the tunnel diode performs operations impossible for any other present-day electron device. It can, for example, permit a greatly increased parts density, withstand cosmic and atomic radiation, and permit electronic computers to make up to a billion "decisions" a second. It also can take all the shock and vibration a space vehicle can dish out.

Other interesting properties of tunnel diodes, he stated, are low noise, insensitivity to temperature changes, low power requirements, and freedom from surface effects.

As a direct result of the incredibly short electron-transit time across the narrow depletion region of the p-n junction, tunnel

diodes are capable of operation at very high frequencies, the RCA engineer pointed out. Oscillation frequencies of 100,000 megacycles are foreseeable. The diodes, he added, can operate as amplifiers, mixers, or detectors.

Dr. Donahue received his degrees in Physical Chemistry from the University of Michigan. He joined the RCA Electron Tube Division at Lancaster, Pa., in 1951 and has made major contributions to the development of color television picture tubes. In the spring of 1958, he was appointed a manager in the Advanced Development activity in the RCA Semiconductor and Materials Division at Somerville. Dr. Donahue and his associates have had a major role in the development of tunnel diodes.

#### SKYSCRAPER COMPUTER CENTER TO BE SHARED BY UNION CARBIDE AND C-E-I-R IN NEW YORK

A new development in the operation of large-scale electronic computing systems has been jointly announced by Union Carbide Corp. and C-E-I-R, Inc. The two companies will share in the use of a high-speed IBM 7090 Computer System.

The transistorized data processing system, capable of 200,000 calculations per second, will be installed this summer on the 36th floor of the new 52-story Union Carbide Building, currently being completed at 270 Park Avenue, New York City. Union Carbide and C-E-I-R, research and computer services firm, of Washington, D.C., and elsewhere, have signed a two-year agreement to divide equally the computing time on the machine.

Union Carbide will use the computer system to solve complex problems in research, development, and engineering. Further, the computer will facilitate the handling of business information within the Corporation. Such a tool will substantially increase the timeliness and accuracy of knowledge presently available to the management and control of the business.

The staff of the Union Carbide Computer Center have specialized backgrounds in the fields of mathematics, statistics, physics, engineering, and systems analysis. They will assist engineers, scientists, and executives in applying high-speed data processing equipment to problems in the interest of increased productivity and higher profitability of the business.

C-E-I-R will make its share of computer time available to business, industrial and government clients on an hourly or job basis. In addition, C-E-I-R will provide a complete range of services to analyze clients' problems, develop the techniques to solve the problems, and to "program" the computer. The company has leased 1½ floors

in the Union Carbide Building, containing 28,000 square feet of office space for the professional staff of mathematicians, statisticians, economists, programmers and specialists in computer applications. C-E-I-R plans to build up its New York Research Center rapidly to a strength of some 200 staff members after it takes occupancy.

All of C-E-I-R's major divisions--Computer Services, Space Technology and Weapons Systems, Mathematical and Statistical Services, Data Research and Management Engineering Divisions--will be represented in the new center, which will thus duplicate all the services available at the company's Research Center in Arlington, Virginia.

Union Carbide Corporation is the nation's second largest chemical company with total sales of over one and one-half billion dollars. In addition to chemicals, the company is a leading producer of plastics, metals, industrial gases and carbon products, and is active in the field of nuclear energy. From its new headquarters building Union Carbide will direct the activities of about 400 plants and 150 sales offices in the United States and Canada, and its numerous affiliated overseas manufacturing and sales companies.

#### SO. CALIF. EDISON TO INSTALL H 800 DATA-PROCESSING SYSTEM

Datamatic Division., Minneapolis Honeywell, Boston, Mass.

Preparing to meet the challenges of a rocketing population within its market area, the Southern California Edison Company has announced that it has contracted for installing an electronic data-processing system to handle the billing of 1,000,000 of its 1,600,000 customers in the Los Angeles area.

Edison is the first public utility in Southern California to adopt electronic computing. It is considering the use of its computer (Honeywell 800) to prepare for anticipated expansion of its number of customers over the coming years, as well as for scientific calculations on engineering projects.

The fully transistorized computer, ordered by Edison from Datamatic, will be placed in operation in 1961 when the utility completes a new \$4,000,000 building in Long Beach, Calif., said J. K. Horton, president. The computing system, to be installed on the 10-story building's ground-floor, will be on display to passersby along the street. Because it utilizes transistors, the Honeywell 800 uses only a tenth of the power and a tenth of the space required by vacuum-tube systems.

Although customer billing--some 25,000 statements will be processed in one workday by the computer--will be its primary job,

the system also will eventually handle both general accounting and engineering problems, said Horton. During its bill-processing, the system will automatically and simultaneously update the customer lists, extract information for reports, edit and print various orders, sort and print out the statements, he explained.

Selection of the Honeywell 800, Horton said, was based on studies which analyzed the integrated capacity of the computer plus peripheral gear to handle Edison's customer accounting on a more economical basis.

The Honeywell 800 is capable of performing up to eight independent jobs simultaneously--a feature called "automatic parallel processing"--which allows high flexibility. The user's ability to fully employ the computer's high speeds and vast power is increased, and delays in scheduling day-to-day work are eliminated.

Edison's system will use six magnetic tape transports to process its million statements. More units will be added as the workload grows, Horton said.

#### COMPUTERS LINKED IN STUDY OF ATLAS MISSILE FLIGHT

American Institute of Electrical Engineers, 29 West 39 St., New York, N.Y.

A "data link" between an analog and a digital computer is helping in the study of simulated flight performance of the Atlas Intercontinental Ballistic Missile.

The device links analog and digital computers at the Astronautics Division of Convair, J. Greenstein, a Convair engineer, reported in a paper presented at a computing devices symposium during the Winter General Meeting of the American Institute of Electrical Engineers in the Hotel Statler-Hilton. Purpose of the link is to solve problems by both digital and analog means, the former having the advantage of greater accuracy, and the latter the advantage of simulating equipment under study, he said in the paper titled "A Two-Channel Data Link for Combined Analog-Digital Simulation".

In order to interconnect its 550 operational analog computer with its Sperry-Rand ERA 1103 digital computer, Convair in 1957 installed a special high speed data link, ordered from Epsco Inc., of Boston. "The data link, called the 'Addaverter' system... contains 15 analog to digital converters, 10 digital to analog converters, and gating and channel selection circuits to transfer binary data between the digital computer and the converters..." Mr. Greenstein said that he believes that a "simplified data link, such as was built at Convair, can also meet the needs of many other computer laboratories."

## ENGINEERING IN A WORLD OF CHANGE

The American Society of Mechanical Engineers,  
29 West 39th Street, New York 18, N.Y.

Engineering's new horizons, and the mechanical engineer's part in shaping them, are described in the new Annual Report of The American Society of Mechanical Engineers entitled, "Engineering in a World of Change".

The newly-published 24 page booklet covers events in the 1959 fiscal year of ASME, in which the Society set a new membership record of 58,421.

Themes of several ASME-sponsored conferences underscored increased interest in a "world of change," keynote of the report. Under ASME auspices, engineers concentrated on missiles, rockets, space capsules, man's role in space, new developments in metallurgy, ceramics, lubricants, plastics for building, solar energy for heating houses, turbine powered autos and new ways of generating electricity. ASME sponsored or co-sponsored 29 meetings from October, 1958, through September of 1959.

A new group, dealing with the relation of man to machine, became part of the Society this year. Known as the Human Factors Group, it has for one of its primary aims promoting better communication between research scientists and the engineers who design new devices.

In a major new service to its members, ASME also began publication of four quarterly journals designed to speed up the flow of information to those interested in the special fields. These journals are: Journals of Engineering for Power, Engineering for Industry, Heat Transfer, and Basic Engineering.

Announcement that ASME will undertake the translation of two Russian books in the coming year is also made in the report. The Society reported that its translation of PMM, the Russian Journal of Applied Mathematics and Mechanics, had proved successful in its first year.

### POWERFUL, MOBILE, AUTOMATIC DIGITAL COMPUTER DELIVERED TO THE ARMY SIGNAL CORPS

Data Processing Systems Div., Sylvania Electronic Products, Needham, Mass.

Sylvania Electric Products Inc. has delivered a high-speed computer installed in a 30-foot Army trailer to Fort Monmouth for evaluation testing by the U. S. Army's Signal Research and Development Laboratory. Sylvania is a subsidiary of General Telephone & Electronics Corporation.

The general-purpose data processing system--called MOBIDIC (Mobile Digital Computer)--was turned over to the Signal Corps following a 270-mile drive from Needham,

Mass., where it was developed and produced by the Data Systems Operations of Sylvania Electronic Systems, a major division of the company.

MOBIDIC is a modern, high-speed mobile data-processing system, as well as one of the most versatile multi-purpose computers developed for general military service.

Special uses include logistics, combat surveillance, tactical operations, scientific or analytic computation, and such applications as map compilation and artillery target assignment. As a general-purpose computer, MOBIDIC is expected to handle all data processing aspects of running a modern field Army, including operations similar to the accounting and inventory control methods of industry.

The U. S. Army Signal Supply Agency, Laboratory Procurement Office, Fort Monmouth, already has contracted for additional models of MOBIDIC for various military uses. Early this month, Sylvania announced receipt of a series of Signal Corps contracts for production of a MOBIDIC system for the Seventh Army Stock Control Center in Zweibrücken, West Germany.

Sylvania Electronic Systems is engaged in research, development and manufacturing activities in advanced electronic fields. In addition to data processing, these include electronic warfare systems, special-purpose tubes and devices, weapons and missile systems, and radar, communications, reconnaissance, navigation and control systems.

### AIEE PANEL SCANS SUBJECT OF ADAPTING HUMAN BRAIN, NERVOUS SYSTEM PRINCIPLES TO MACHINES

American Institute of Electrical Engineers,  
29 West 39th Street, New York 18, N.Y.

The question of how the workings of the human brain and nervous system can be adapted to machines so that man can design better communications equipment was the subject of a panel discussion during the five-day Winter General Meeting of the American Institute of Electrical Engineers.

Taking part in the panel, which is titled "Parallel Computations of the Nervous System - Reliability Through Redundancy," are Dr. Warren McCulloch of the Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Mass.; Dr. Oliver Selfridge, Lincoln Laboratory, Massachusetts Institute of Technology; and Dr. Heintz Von Furster, University of Illinois, Urbana, Illinois.

"Scientists have long been aware of the remarkable powers of the human brain and nervous system to utilize astonishingly small quantities of sense data to arrive at reli-



able decisions regarding the external world," said Kenneth W. Jarvis, Winnetka, Illinois, chairman of the panel. "This ability exceeds by far the capacity of devices or machines designed by engineers. It is believed that a great advance in the reliability of operation of equipment could be made if analogs of the brain and nervous system could be used in the design of communication equipment.

"It seems that one factor in this remarkable capacity is that parallel sensory paths are utilized and their outputs compared at various levels. Most probable values of the sense data are computed and cross compared, resulting in a high degree of reliability. In essence, operation is in parallel rather than serially."

#### DIGITAL COMPUTER AIDS TRAIN MOVEMENT ON SINGLE TRACK LINE

American Institute of Electrical Engineers,  
29 West 39th Street, New York 18, N.Y.

The digital computer is "riding the rails" in this age of automation.

These electronic brains now can be used to help railroad management operate two-way traffic on single-track rights of way, a land transportation symposium was told during the General Meeting of the American Institute of Electrical Engineers.

"A digital computer program has been designed to aid railroad management in selecting the proper siding locations and signal spacing when considering a centralized traffic control system," three General Railway Signal Company engineers said in a paper, A Digital Computer Simulation of Single Track Railroad Operation. "Using an IBM model 650 computer the traffic pattern of up to 10 trains operating at one time on a 100 to 150 mile division of a railroad can be predicted. The initial information stored in the computer memory describes the grades, curves, speed restrictions, signal locations and track layout of the railroad. Also data for each train are available to the computer. This information includes the number, weight, and type of cars, the power of the locomotive, the origin and destination and the time of departure."

The authors were R. T. Coupal, L. L. Garver and W. R. Smith, of Rochester, N.Y.

Improved signal systems such as Centralized Traffic Control, have enabled railroads to move traffic on a single mainline track with passing sidings, in place of two or more tracks, they explained.

They said that new data for a complete change in track and signal layout may be prepared from blueprints in one-half day. Train data such as departing time may be changed in a few minutes. The computer

takes about eight minutes to calculate one of many trains over 100 miles of railroad.

"The program offers a relatively easy method to evaluate many proposed changes in either the right-of-way or the operating schedule without the expense and difficulty involved in actual field tests," they concluded.

#### INSTALLATION OF NEW DATA PROCESSING SYSTEM TO CUT STEEL ORDER PROCESSING FROM DAYS TO MINUTES

Sharon Steel Corp., Sharon, Pa.

Steel orders which take days to process under normal conditions soon will require only minutes, as the result of the installation at Sharon Steel Corp. of the first IBM computer system of its type in the steel industry employing complete order entry, facilities loading, scheduling, inventory control, billing and invoicing programs. Full beneficial operation is expected by mid-year.

"Improved customer service through swifter, more accurate scheduling and processing of orders is the first benefit expected from the new system," said James A. Roemer, Chairman of the Board, "enabling us to assign and hold more closely to delivery dates. We have been programming for this computer for approximately one year. Due to the complexity of the steel business a method of feeding information to the computers has been difficult to achieve. We now have such a system and whereas other companies have been able to do the job in part, we are on the threshold of doing it in its entirety.

"Ultimately we plan to process all paper work to record adequately all production dates, and to assemble and schedule all the orders our company may have over a given period of business. We also plan to feed data to the equipment on which important managerial, sales, market research, purchasing, metallurgical, research, engineering and production decisions can be based.

"We have laid the groundwork for this achievement with the present installation. We shall add additional equipment as rapidly as possible to achieve all the goals we have in mind."

Valued in excess of \$1 million the 14 tons of IBM equipment now installed in 3019 square feet of working area at the Roemer Works comprises 14 separate components which are the working elements of the 650 tape - RAMAC computer.

COMPUTER LANGUAGE TRANSLATOR  
SPEEDS PROCESSING OF HOUND DOG DATA  
AT NORTH AMERICAN AVIATION

Electronic Engineering Company of California,  
1601 East Chestnut Ave., Santa Ana, Calif.

A Model ZA-100 Computer Language Translator system is enabling flight test engineers at the North American Aviation Division here to translate three minutes of raw telemetry data into 2250 IBM cards or print it out on an electric typewriter at the rate of 1778 characters per second.

The North American Aviation CLT installation is now being employed to translate data from tests of the Hound Dog Missile. The system receives special airborne digital magnetic tapes, Millisadic computer tapes, IBM 727 magnetic tapes, Flexowriter punched paper tapes, and IBM punched cards. Translations are made into all of these formats except Millisadic and digital magnetic tapes which are used only as input media.

Input data in the case of telemetry information is in the form of 14-channel magnetic tape. The Translator accepts three minutes of raw data, compresses it into three-quarters of a minute to conserve processing time, and then begins accepting 2250 blocks of binary data with each block made up of six each 13-bit binary time data words per frame or input block. The Translator takes only 45 seconds to convert this information to a BCD format acceptable to the IBM 727.

In the IBM computer tape format the data appears as 36 output characters per block plus lateral parity characters. The CLT puts out 50 output blocks per second. It is possible to further increase the capacity of the machine by conserving blocks, that is, by using 72 characters plus lateral parity to each block. Under this method 25 output blocks are produced each second.

To maintain a quantity control on this data all raw input information is "quick-looked" before it is put through the CLT and the IBM 727. When the translation is completed, three minutes of magnetic tape recorded data from an FR-114 tape machine will equal 2250 IBM cards or will require two and one-quarter hours of typing time on the standard electric typewriter.

NEW TRANSISTORIZED DIGITAL MODULES

Control Equipment Corporation, 19 Kearny Rd.,  
Needham Heights, Mass.

A new family of compatible transistorized digital modules used to assemble digital systems without designing circuits has been developed.

This new line includes neon indicators on flip flops and shift registers, and allowance for use of a remote indicator.

The modules are designed for operation within a temperature range of -45°C. to +65°C. They have an overall size of 3-1/16" x 3-3/8", with an approximate weight of 1.5 oz. each.

A wide variety of types are available, including flip flops, shift registers, multi-vibrators, one-shots, dc logic, and many others.

Among the applications are digital systems, automation, timing and control, data processing, test equipment, instrumentation, and digital servos.

MAGNETIC TAPE SALES NOT AFFECTED  
BY NEW GENERAL ELECTRIC RECORDING PROCESS  
SAYS AUDIO DEVICES

Audio Devices, Inc., 444 Madison Ave., New  
York 22, N.Y.

C. J. LeBel, vice-president of Audio Devices, Inc., a leading manufacturer of magnetic recording tapes, has made the following comments on the General Electric thermoplastic recording method demonstrated on Tuesday in New York City. "Our active program for the development of superior magnetic tapes for video recording and other precision applications will in no way be affected by the announcement of a new technique by General Electric.

"We at Audio Devices," Mr. LeBel continues, "are convinced that the thermoplastic principle disclosed will not affect production or sales of magnetic tape. We also believe it will not replace most magnetic recording, even in the future."

In referring to the demonstration of the new technique, Mr. LeBel comments "Thermoplastic recording for television lacks the dynamic range of magnetic video tape which has already proven its superiority over earlier photographic film. Because of the inability of the new process to erase and record a single digit, it is unsuitable for computer use. In data storage, because of the high density claimed for this new method, it may eventually allow greater compactness than the present process, but film fragility appears to be an intrinsic problem. For sound recording, the thermoplastic method is inherently complex. It may well develop a specialized application of its own in some portion of television or in other recording. The new method, however, has fundamental limitations (such as the need for a high vacuum chamber) which will keep it from most applications.

"Audio Devices will continue to follow this development with interest," Mr. LeBel concludes "since our knowledge of the technology of precision coating will be essential

in the production of thermoplastic material for the new process. We will, of course, make this material available should our customers require it."

#### CONTRACT FOR NEW BERNOUILLI-DISK MEMORY DEVICE

Laboratory for Electronics, 1079 Commonwealth Ave., Boston 15, Mass.

Laboratory for Electronics' Computer Products Division in Boston has received from Lockheed Missile and Space Division, a production contract totaling over 1/2 Million Dollars for the Computer Products Division's newly developed Bernouilli-Disk Memory System.

The device, a product of LFE's Research Program, is one of the simplest rotating storage systems ever developed. Because of its simplicity, the system is highly reliable, resistant to shock, temperature and vibration, and is exceptionally compact and light weight. Having low power requirements, within the range of outputs available in solar batteries, the Disk Storage System will be used by Lockheed in their Sattelite System Program.

#### EUROPEAN CONSOLIDATION OF DIEBOLD ORGANIZATIONS

John Diebold & Associates, New York, N.Y.

The John Diebold Group of Management Consulting Firms, consisting of ALDERSON ASSOCIATES, INC. (Marketing and Marketing Research), GRIFFENHAGEN-KROEGER, INC. (Public Administration and Finance), and JOHN DIEBOLD & ASSOCIATES, INC. (Automation and Automatic Data Processing) have consolidated their European activities into one company, to provide a full range of specialized management consulting services in Europe. Its name is JOHN DIEBOLD & ASSOCIATES, EUROPE S.A. and offices are in London, Amsterdam, Paris, Frankfurt, and Rome.

#### NEW-DESIGN PROCESS CONTROL COMPUTER PASSES SIX-MONTH MARK IN MARATHON RUN

Control Systems Div., Daystrom, Inc., LaJolla, Calif.

The New Year at an electric power generating station near New Orleans marks a significant milestone in industry's search for a means of operating its plants automatically, continuously and without shutdown for service or maintenance through electronic computer equipment.

Records certified on January 1 revealed that complex data logging and computer equipment, installed by Daystrom, Inc., at the Sterlington station of The Louisiana Power

and Light Company, near New Orleans, operated 99.76 per cent of the time 24 hours a day, 7 days a week for the past six months. This degree of reliability has not previously been in industrial operations.

"The achievement was made possible through new design techniques developed by Daystrom, the elimination of moving parts, and the replacement of electronic tubes with solid state components, such as transistors," according to Thomas R. Jones, president of Daystrom, Inc., whose Control Systems Division of La Jolla, California, designed, produced and installed the system.

This six-month test--the first of its kind and one of the most demanding ever imposed upon electronic computer equipment--"demonstrates and underscores the rapid development that has been achieved in solid state electronic systems during the last two to three years," the manufacturer added. "It means that widespread automatic control of industrial plants is not far away in time."

Reliability is not a stringent requirement in business and scientific computers which solve individual problems intermittently, Mr. Jones observed. "But," he continued, "our design goal was to meet the much higher reliability requirements necessary for continuous operation of industrial plants. At the time of the Sterlington negotiations, we felt confident that our development work had accomplished these objectives to the extent that we took the initiative and became the first and only manufacturer to guarantee our computer systems to operate better than 99 per cent of the time, 24 hours a day, 7 days a week. Many experts thought that this goal was preposterous. The power company's records disclose that the Sterlington plant actually bettered our guarantee, which has justified our confidence in establishing this precedent.

"The few times that the equipment was out of service, maintenance personnel found that the trouble was in accessory equipment. It is significant--and highly promising--that Sterlington lost not one minute because of the failure of the Daystrom computer - the heart of the equipment - although some 4 thousand transistors and 7.5 thousand diodes were involved in the equipment.

"What this means is that design advances made in solid state development assure complete reliability--complete dependability--in any industrial operation. No longer need industry worry about costly shutdowns--nor even 'normal' maintenance, caused by control equipment, if it uses automation based on such design criteria utilizing solid state circuitry."

AUTOMATIC PROGRAMMING OF DIGITAL COMPUTERS  
--NATIONAL INFORMATION CENTRE, GREAT BRITAIN

Richard Goodman, Organizing Secretary, Brighton  
Technical College, Brighton 7, England

I have pleasure in enclosing a statement of the aims, organization and services of the above newly established National Information Centre concerned with the automatic programming of digital computers and allied topics.

The broad composition of the Advisory Committee and the two publications, the Annual Review in Automatic Programming and the English translation of the Russian journal Problems in Cybernetics are, we believe, especially worthy of note. The first volumes of both these journals will appear shortly.

I shall be grateful for whatever notice you may be able to give us.

Automatic Programming  
of Digital Computers  
National Information Centre

#### 1. Origin and Purpose

The National Centre of Information on Automatic Programming of Digital Computers has been established by the Department of Mathematics of the Brighton Technical College in response to a recommendation of the first National Conference on Automatic Programming held in Brighton in April, 1959. This conference was attended by 111 delegates from computer manufacturers, industrial and commercial computer users, government research establishments, universities and technical colleges.

The purpose of the Centre is:

(i) to establish and maintain a comprehensive library of publications, papers, research reports and other material, especially those not readily accessible, in any way relevant to the problems of automatic programming, and to make these available, in English, on demand;

(ii) to publish, in conjunction with Pergamon Press Limited, an annual review in Automatic Programming;

(iii) to provide a 'clearing house' for information and enquiries on automatic programming and related topics, and to help co-ordinate the work of other bodies active in this field;

(iv) to organize from time to time, small working conferences on particular aspects of the subject;

(v) to maintain permanent contact with organizations in all other countries concerned with such matters.

#### 2. Organization

An advisory Committee to assist the work of the Centre has been established and includes Dr. A. D. Booth (University of London), Mr. R. A. Brooker (University of Manchester),

Mr. P. V. Ellis (Internat'l. Computers and Tabulators Ltd.), Dr. S. Gill (Ferranti Ltd.), Dr. J. Howlett (United Kingdom Atomic Energy Authority), Dr. R. J. Ord-Smith (Standard Telephones and Cables Ltd.), Mr. C. Robinson (English Electric Co. Ltd.), Mr. Christopher Strachey, Mr. A. E. Taylor (Remington Rand, Univac), Mr. J. H. Wensley (Computer Developments Ltd.), and Mr. M. Woodger (Mathematics Division, Nat'l. Physical Laboratory) together with the following as corresponding members:

Dr. Grace Hopper (Remington Rand, U.S.A.), Dr. L. Luckaszewicz (Mathematical Machines Laboratory, Polish Academy of Sciences) and Prof. H. Rutishauer (Institute of Applied Mathematics, Zurich).

The Organizing Secretary is Mr. Richard Goodman, M.A., B.Sc., of the Computing Laboratory, Department of Mathematics, Brighton Technical College (Telephone: Brighton 66544); the Librarian is Miss Ethel Garratt, M.A., A.L.A.

#### 3. Publications

The Centre publishes in conjunction with Pergamon Press Ltd., the Annual Review in Automatic Programming which contains original papers, reprints and abstracts of relevant material published elsewhere, and critical notices. Price to non-members is Two Guineas per volume.

From time to time, a Bulletin of Abstracts is issued to members in duplicated form, together with a list of volumes and other material recently acquired by the Centre Library.

The Centre Library relies, for its part, on the co-operation of computer manufacturers and users in supplying it with copies of their publications and reports.

#### 4. Membership

The Centre is a self-supporting organization relying upon the subscriptions of its members and donations from interested bodies. The annual Institutional Membership subscription is Twenty Guineas; the annual subscription for Individual Membership (which is restricted) is Five Guineas. Both subscriptions cover the period 1 January to 31 December and are payable in advance. Cheques should be made payable to BRIGHTON TECHNICAL COLLEGE.

Membership of the Centre entitles organizations and individuals to the use of information and library services (on a postal basis), free copies of the Annual Review and the Bulletin of Abstracts, and reduced fees for delegates to any conference or symposium organized by the Centre. In addition, by arrangement with the publishers, members of the Centre may obtain copies of the English edition of the Russian journal, Problems of Cybernetics, at a reduced price.



# NATIONAL SYMPOSIUM ON MACHINE TRANSLATION

February 2-5, 1960

AT UNIVERSITY OF CALIFORNIA, LOS ANGELES

## PRESENTED BY:

University of California, Berkeley  
University of California, Los Angeles  
University of Southern California,  
Los Angeles  
University of Washington, Seattle

The Four Cooperating Universities express their interest in this important field by sponsoring a National Symposium on Machine Translation to provide an accurate appraisal of the current state of progress and a description of methods now being exploited.

## The Symposium is intended for:

Professionals active in the field of  
Machine Translation  
Linguists and language scholars

## The Symposium will be of interest to:

Computer scientists  
Information retrieval specialists  
Librarians and documentalists  
Manufacturers of data processing  
equipment

## Program Planning Committee:

Harold P. Edmundson, Senior Associate,  
Planning Research Corp., Los Angeles.  
Robert M. Hayes, Scientific Director,  
Electrada Corp., Beverly Hills.  
Sydney M. Lamb, Assistant Research Lin-  
guist, Univ. of California, Berkeley.  
Lew R. Micklesen, Linguist, IBM Research  
Center.  
Charles B. Tompkins, Professor of Mathe-  
matics and Director, Numerical Analy-  
sis Research, Univ. of California,  
Los Angeles.  
Sam M. Houston, Assistant Head, Engineer-  
ing Extension, Univ. of California,  
Los Angeles.  
Eleazer Lecky, Professor of English,  
Univ. of Southern California.  
H. L. Tallman, Assistant Head, Physical  
Sciences Extension, Univ. of Califor-  
nia, Los Angeles.

## PROGRAM

Tuesday - February 2

### Morning

Registration--in foyer of Business Administra-  
tion and Economics Building, room 147.

"Welcome to University of California,  
Los Angeles"

George W. Brown, Director, Western Data  
Processing Center, University of Cali-  
fornia, Los Angeles.

"Orientation to Symposium"

H. P. Edmundson, Planning Research Corp.

### SESSION 1: CURRENT RESEARCH

CHAIRMAN: Leon Dostert, Georgetown University

THE RAND CORPORATION--

David G. Hays.

RAMO-WOOLDRIDGE CORPORATION--

Jules Mersel.

CARNEGIE INSTITUTE OF TECHNOLOGY--

Alan J. Perlis.

"SOVIET RESEARCH"-- Kenneth Harper,  
The RAND Corporation

### SESSION 2: CURRENT RESEARCH

#### Afternoon

CHAIRMAN: E. W. Cannon, National Bureau of  
Standards.

INTERNATIONAL BUSINESS MACHINES--

Gilbert King.

GEORGETOWN UNIVERSITY--

Michael Zarechnak, A. F. R. Brown.

MACHINE TRANSLATIONS, INC.--

Ariadne W. Lukjanov.

UNIVERSITY OF TEXAS--  
Stanley N. Werbow.  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY--  
Victor H. Yngve.  
NATIONAL BUREAU OF STANDARDS--  
Ida Rhodes.

Wednesday - February 3

SESSION 3: CURRENT RESEARCH

Morning

CHAIRMAN: Thomas A. Sebeok, Indiana University.

UNIVERSITY OF CALIFORNIA--  
Sydney M. Lamb.

UNIVERSITY OF WASHINGTON--  
Erwin Reifler.

WAYNE STATE UNIVERSITY--  
Harry H. Josselson

HARVARD UNIVERSITY--  
Anthony G. Oettinger.

SESSION 4: PANEL ON METHODOLOGY

Afternoon

A discussion of the various methods being used in Machine Translation research as revealed in the project reports of the first three sessions. Participants include one member of each group, in most cases the person who presented the report in Sessions 1, 2 or 3.

In what ways do the methods and approaches now in use differ from one another? To what extent do they complement each other? To what extent do they duplicate each other?

Would closer cooperation between the various groups be desirable? If so, how can this be achieved?

What qualities of translation are we aiming for?

In what ways are the various sources of linguistic information being exploited?

What standards and criteria for reliability are being applied?

CHAIRMAN: Robert M. Hayes, Electrada Corporation.

INTRODUCER: H. P. Edmundson

DISCUSSANTS:

A. F. R. Brown  
Vincent Guiliano, Arthur D. Little, Inc.  
David G. Hays, The RAND Corporation.  
Harry H. Josselson, Wayne State Univ.  
Gilbert King, IBM Research Center.

Sydney M. Lamb, Univ. of California, Berkeley.  
Adriadne Lukjanov, Machine Translation, Inc.; C.E.I.R.  
Anthony G. Oettinger, Harvard University.  
Alan J. Perlis, Carnegie Institute of Technology  
Erwin Reifler, University of Washington.  
Ida Rhodes, National Bureau of Standards.  
Don R. Swanson, Ramo Wooldridge Corp.  
Stanley N. Werbow, University of Texas.  
Victor H. Yngve, Massachusetts Institute of Technology.  
Michael Zarechnak, Georgetown University.

SESSION 5: GRAMMATICAL STUDIES

What is the role of grammatical analysis in Machine Translation research?  
How can grammatical manipulations be dealt with efficiently by machine?

CHAIRMAN: Robert M. Hayes, Electrada Corp.

SPEAKERS:

"Automatic English Inflection"  
William D. Foust, Harvard University.  
"German Syntax Patterns"  
Joseph W. Marchand, Univ. of California, Berkeley  
"The Use of Grammars within the Mechanical Translation Routine"  
G. H. Matthews, Massachusetts Institute of Technology.

Thursday - February 4

SESSION 6: SYNTAX

What type of syntactic theory is most useful for machine translation?  
To what extent should structural description precede the development of syntactic routines?  
Does an automatic translator need to do a complete syntactic analysis of every sentence of texts being translated?

CHAIRMAN: C. B. Tompkins, University of California, Los Angeles.

INTRODUCER: Kenneth Harper, University of California, Los Angeles; The RAND Corp.

SPEAKERS:

"Grouping and Dependency Theories"  
David G. Hays, The RAND Corporation  
"Nesting Within the Prepositional Structure"  
Michael Zarechnak, Georgetown Univ.

**"The German Noun Phrase"**

Joseph R. Applegate, Massachusetts  
Institute of Technology

**"Syntactic Information Retrieval"**

Paul L. Garvin, Georgetown University;  
Ramo-Wooldridge; Wayne State University.

**DISCUSSANTS:**

Evelyn Bristol, University of California,  
Berkeley.

A. F. R. Brown, Georgetown University.

Lew R. Micklesen, IBM Research Center.

Murray E. Sherry, Harvard University.

**SESSION 7: THE DICTIONARY**

**Afternoon**

What is the role of the dictionary in a Machine Translation system?

What information should be contained in a dictionary entry and how should it be organized?

What size of lexical units should be operated with (i.e. words, groups of words, or parts of words)?

Should we cut off the suffixes, prefixes, inflectional affixes only or no affixes at all? How is the operation to be performed on the machine?

How should the dictionary be organized in the machine to maximize its size and minimize look-up time?

**CHAIRMAN:** George W. Brown, University of California, Los Angeles.

**INTRODUCER:** Don R. Swanson, Ramo Wooldridge Corp.

**SPEAKERS:**

**"The Solution of Machine Translation Linguistic Problems through Lexicography"**

Erwin Reifler, Univ. of Washington.

**"Automatic Affix Interpretation"**

Murray E. Sherry, Harvard University.

**"Glossary Look-up Made Easy"**

Ted Ziehe, The RAND Corporation.

**"Segmentation"**

Sydney M. Lamb, Univ. of California, Berkeley.

**DISCUSSANTS:**

Vincent Guiliano, Arthur D. Little, Inc.

Harry H. Josselson, Wayne State Univ.

Winifred P. Lehman, University of Texas.

Gilbert King, IBM Research Center.

Jules Mersel, Ramo Wooldridge Corp.

**SESSION 8: INFORMATION PROCESSING AND LINGUISTIC ANALYSIS**

What contributions can research in machine translation make to general linguistics?

What contributions can linguistics make to machine translation?

What contributions can linguistics and machine translation make to the general area of information processing?

What kinds of basic research can be expected to provide the greatest contribution to machine translation and to information processing in general?

What future developments can be expected in the field of information processing?

**CHAIRMAN:** George W. Brown, University of California, Los Angeles.

**INTRODUCER:** H. P. Edmundson, Planning Research Corp.

**SPEAKERS:**

**"From Text to Topics in Mechanized Searching Systems"**

Thyllis Williams, ITEK Corporation.

**"A New Theory of Translation and its Application"**

Anthony G. Oettinger, Harvard University.

**"Information Processing and Linguistic Analysis: from 'Model to Procedure'"**

Paul Garvin, Georgetown University.

**DISCUSSANTS:**

Harry H. Josselson, Wayne State Univ.

G. H. Matthews, Massachusetts Institute of Technology.

Victor Oswald, Planning Research Corp.  
Introducer and Speakers

Friday - February 5

**SESSION 9: SEMANTIC RESOLUTION**

How will an automatic translator select appropriate target equivalents for units of the source language?

What are the practical and theoretical limitations to the solution of semantic problems?

**CHAIRMAN:** Mary R. Haas, Univ. of California, Berkeley.

**INTRODUCER:** Victor Oswald, Univ. of California, Los Angeles; Planning Research Corp.

**SPEAKERS:**

"The Nature of the Multiple Meaning Problem"

Don R. Swanson, Ramo Wooldridge Corp.

"Semantic Classification"

Ariadne W. Lukjanov, Machine Translation Inc.; C.E.I.R.

"An Experiment in the Automatic Selection or Rejection of Technical Terms"

Lew R. Micklesen, IBM Research Center.

"The Application of Redundancy Techniques to Semantic Problems"

Ramon Faulk, University of Texas.

**DISCUSSANTS:**

Joseph R. Applegate, Massachusetts Institute of Technology.

Leon Dostert, Georgetown University.

Paul L. Garvin, Georgetown University.

Kenneth Harper, Univ. of California, Los Angeles; Ramo Wooldridge Corp.

**SESSION 10: PROGRAMMING AND SUPERPROGRAMMING FOR MACHINE TRANSLATION**

**Afternoon**

Have we made programming for Machine Translation easier, more effective, more automatic?

**CHAIRMAN:** Willis Ware, The RAND Corporation.

**INTRODUCER:** Alan J. Perlis, Carnegie Institute of Technology.

**SPEAKERS:**

"The Comit System"

Victor H. Yngve, Massachusetts Institute of Technology.

"Flexibility vs. Speed"

A. F. R. Brown, Georgetown University.

"Mimic: A Translation of English Coding"

Hugh Kelly, The RAND Corporation.

"The Automatic Synthesis of Translation Algorithms"

Vincent Guiliano, Arthur D. Little, Inc.

**DISCUSSANTS:**

B. D. Blickstein, C.E.I.R., Inc.

Amelia Janiotis, Wayne State University.

William Jacobsen, Jr., University of California, Berkeley.

Peter Toma, Georgetown University.

Robert E. Wall, Univ. of Washington.

Introducer and Speakers

**SESSION 11: DESIGN OF EQUIPMENT FOR INFORMATION PROCESSING**

**Afternoon**

How have current computers failed or been inconveniently designed for the manipulation of linguistic rather than numeric material?

What are the needs for linguistic analysis versus numerical analysis?

What are the comparative merits of various computers?

Storage and scanning needs.

**CHAIRMAN:** Willis Ware, The RAND Corporation.

**INTRODUCER:** Vincent Guiliano, Arthur D. Little, Inc.

**SPEAKERS:**

"The High-speed General Purpose computers in Machine Translation"

B. D. Blickstein, C.E.I.R., Inc.

"System Design of a Computer for Russian English Translation"

Robert E. Wall, Univ. of Washington.

"Modern Trends in Character Recognition Machines"

Ida Rhodes, National Bureau of Standards

**DISCUSSANTS:**

Don R. Swanson, Ramo Wooldridge Corp.

H. P. Edmundson, Planning Research Corp.

Robert M. Hayes, Electrada Corporation.

Peter Toma, Georgetown University.

Jules Mersel, Ramo Wooldridge Corp.

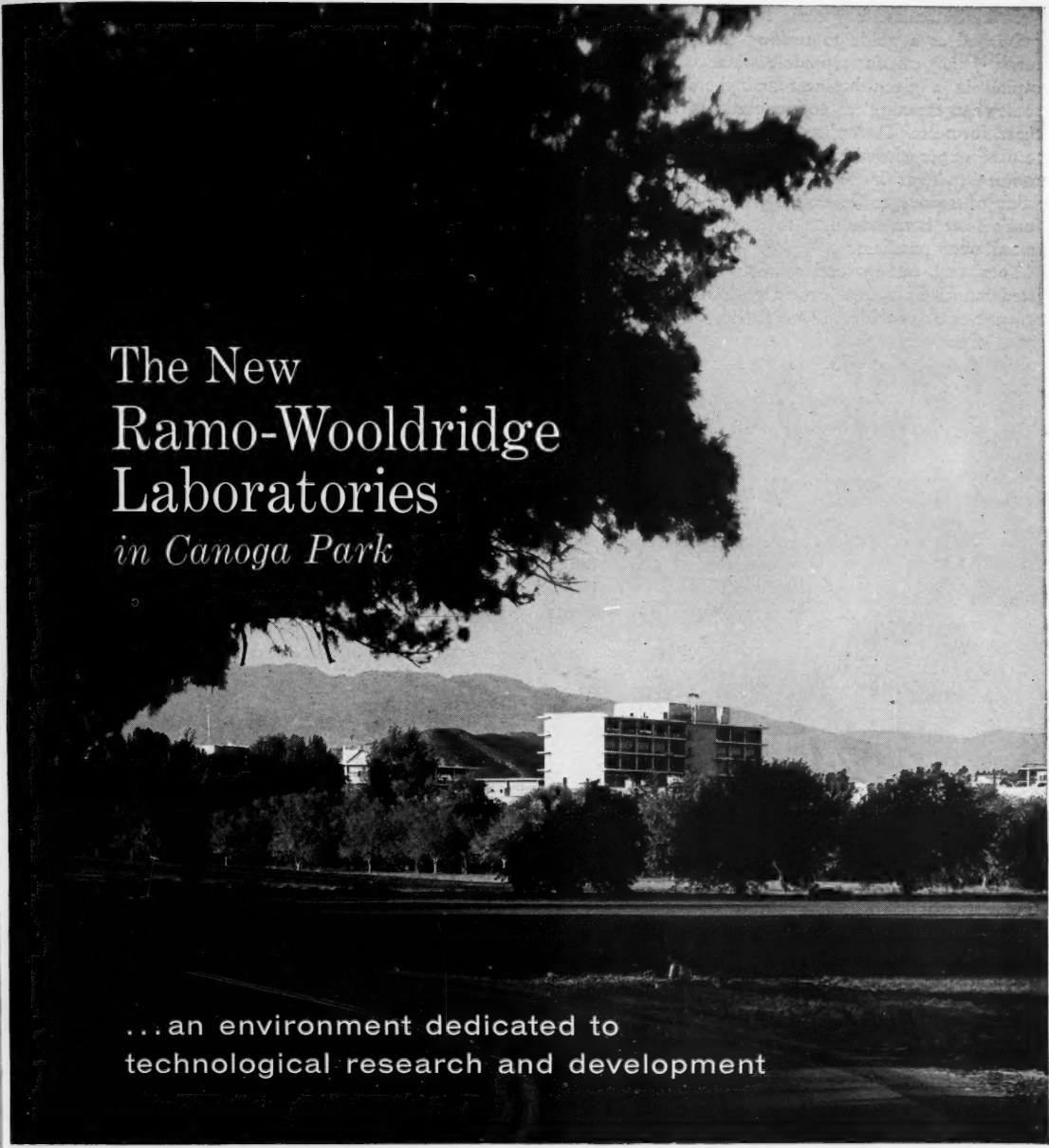
"Conclusion to Symposium"

H. P. Edmundson, Planning Research Corp.

**INFORMATION:**

For additional information concerning the program, write or call Engineering Extension, Room 6266, Engineering Building Unit II, University of California, Los Angeles 24, California. GRanite 3-0971, Extension 9877 or 369. TWX: West Los Angeles 6705.





# The New Ramo-Wooldridge Laboratories *in Canoga Park*

...an environment dedicated to  
technological research and development

The new Ramo-Wooldridge Laboratories in Canoga Park, California, will provide an excellent environment for scientists and engineers engaged in technological research and development. Because of the high degree of scientific and engineering effort involved in Ramo-Wooldridge programs, technically trained people are assigned a more dominant role in the management of the organization than is customary.

The ninety-acre landscaped site, with modern buildings grouped around a central mall, contributes to the

academic environment necessary for creative work. The new Laboratories will be the West Coast headquarters of Thompson Ramo Wooldridge Inc. as well as house the Ramo-Wooldridge division of TRW.

The Ramo-Wooldridge Laboratories are engaged in the broad fields of electronic systems technology, computers, and data processing. Outstanding opportunities exist for scientists and engineers.

*For specific information on current openings write to Mr. D. L. Pyke.*



**THE RAMO-WOOLDRIDGE LABORATORIES**

8433 FALLBROOK AVENUE, CANOGA PARK, CALIFORNIA

**SPEAKERS:**

"The Nature of the Multiple Meaning Problem"

Don R. Swanson, Ramo Wooldridge Corp.

"Semantic Classification"

Ariadne W. Lukjanov, Machine Translation Inc.; C.E.I.R.

"An Experiment in the Automatic Selection or Rejection of Technical Terms"

Lew R. Micklesen, IBM Research Center.

"The Application of Redundancy Techniques to Semantic Problems"

Ramon Faulk, University of Texas.

**DISCUSSANTS:**

Joseph R. Applegate, Massachusetts Institute of Technology.

Leon Dostert, Georgetown University.

Paul L. Garvin, Georgetown University.

Kenneth Harper, Univ. of California, Los Angeles; Ramo Wooldridge Corp.

**SESSION 10: PROGRAMMING AND SUPERPROGRAMMING FOR MACHINE TRANSLATION**

**Afternoon**

Have we made programming for Machine Translation easier, more effective, more automatic?

**CHAIRMAN:** Willis Ware, The RAND Corporation.

**INTRODUCER:** Alan J. Perlis, Carnegie Institute of Technology.

**SPEAKERS:**

"The Comit System"

Victor H. Yngve, Massachusetts Institute of Technology.

"Flexibility vs. Speed"

A. F. R. Brown, Georgetown University.

"Mimic: A Translation of English Coding"

Hugh Kelly, The RAND Corporation.

"The Automatic Synthesis of Translation Algorithms"

Vincent Guiliano, Arthur D. Little, Inc.

**DISCUSSANTS:**

B. D. Blickstein, C.E.I.R., Inc.

Amelia Janiotis, Wayne State University.

William Jacobsen, Jr., University of California, Berkeley.

Peter Toma, Georgetown University.

Robert E. Wall, Univ. of Washington.

Introducer and Speakers

**SESSION 11: DESIGN OF EQUIPMENT FOR INFORMATION PROCESSING**

**Afternoon**

How have current computers failed or been inconveniently designed for the manipulation of linguistic rather than numeric material?

What are the needs for linguistic analysis versus numerical analysis?

What are the comparative merits of various computers?

Storage and scanning needs.

**CHAIRMAN:** Willis Ware, The RAND Corporation.

**INTRODUCER:** Vincent Guiliano, Arthur D. Little, Inc.

**SPEAKERS:**

"The High-speed General Purpose computers in Machine Translation"

B. D. Blickstein, C.E.I.R., Inc.

"System Design of a Computer for Russian English Translation"

Robert E. Wall, Univ. of Washington.

"Modern Trends in Character Recognition Machines"

Ida Rhodes, National Bureau of Standards

**DISCUSSANTS:**

Don R. Swanson, Ramo Wooldridge Corp.

H. P. Edmundson, Planning Research Corp.

Robert M. Hayes, Electrada Corporation.

Peter Toma, Georgetown University.

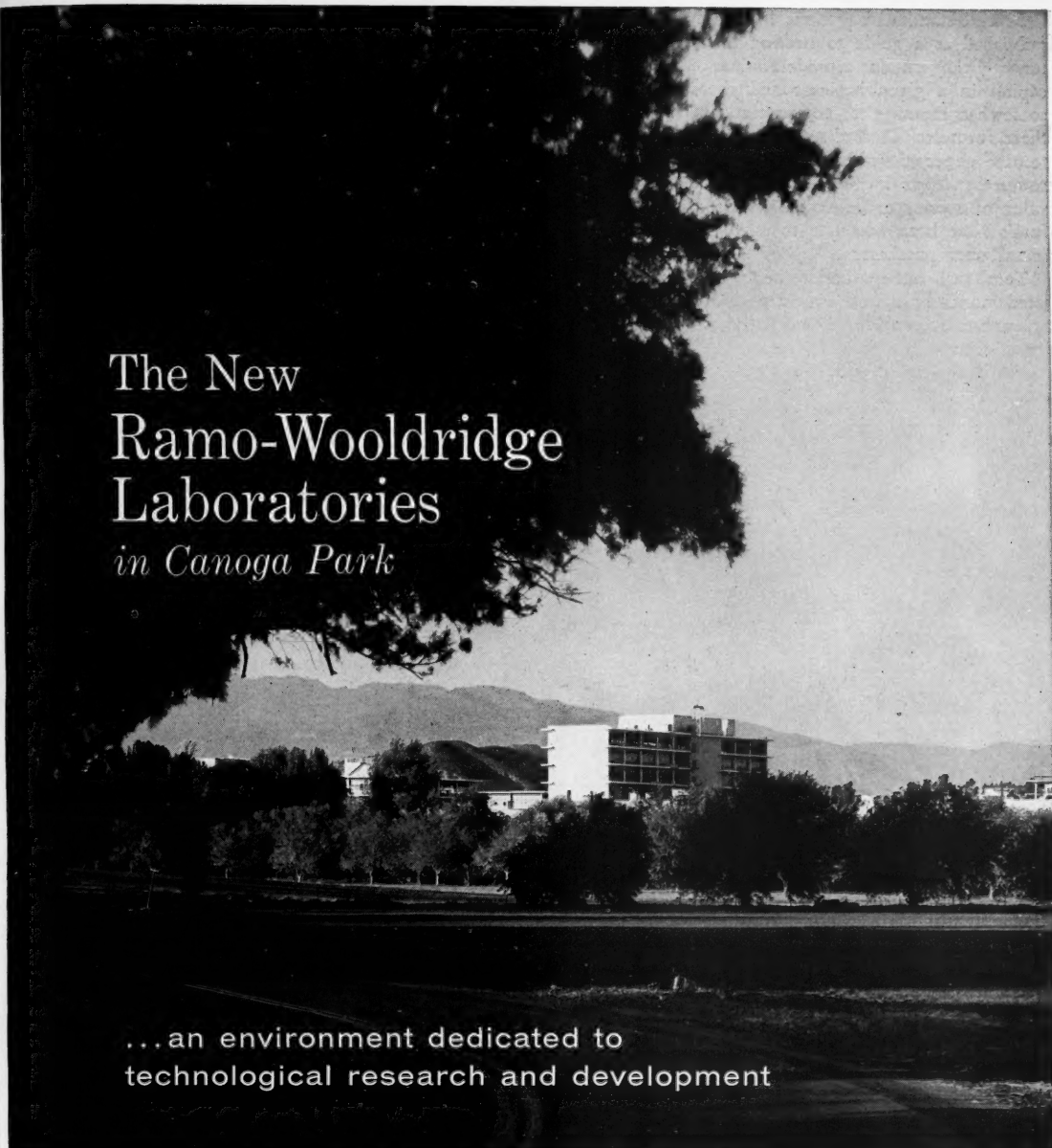
Jules Mersel, Ramo Wooldridge Corp.

"Conclusion to Symposium"

H. P. Edmundson, Planning Research Corp.

**INFORMATION:**

For additional information concerning the program, write or call Engineering Extension, Room 6266, Engineering Building Unit II, University of California, Los Angeles 24, California. GRanite 3-0971, Extension 9877 or 369. TWX: West Los Angeles 6705.



# The New Ramo-Wooldridge Laboratories *in Canoga Park*

...an environment dedicated to  
technological research and development

The new Ramo-Wooldridge Laboratories in Canoga Park, California, will provide an excellent environment for scientists and engineers engaged in technological research and development. Because of the high degree of scientific and engineering effort involved in Ramo-Wooldridge programs, technically trained people are assigned a more dominant role in the management of the organization than is customary.

The ninety-acre landscaped site, with modern buildings grouped around a central mall, contributes to the

academic environment necessary for creative work. The new Laboratories will be the West Coast headquarters of Thompson Ramo Wooldridge Inc. as well as house the Ramo-Wooldridge division of TRW.

The Ramo-Wooldridge Laboratories are engaged in the broad fields of electronic systems technology, computers, and data processing. Outstanding opportunities exist for scientists and engineers.

*For specific information on current openings write to Mr. D. L. Pyke.*



**THE RAMO-WOOLDRIDGE LABORATORIES**

8433 FALLBROOK AVENUE, CANOGA PARK, CALIFORNIA

Several standard equations have been developed and published as a guide to making this decision. Unfortunately they call for a predetermination of the value of capital in a given business and therefore it becomes somewhat meaningless to generalize with the use of these formulas. Accordingly, we will deal with an alternate approach which seems easier to develop and comprehend. It is sufficiently sensitive to the future value of money to determine if the earnings of freed funds have been adequate to cover the excess cost of rental over purchase.

Total cash outlays under the two plans are accumulated month by month over a period of as many years as appears reasonable. Depreciation, not being a cash item, is excluded from these computations except as it affects the payment of income taxes.

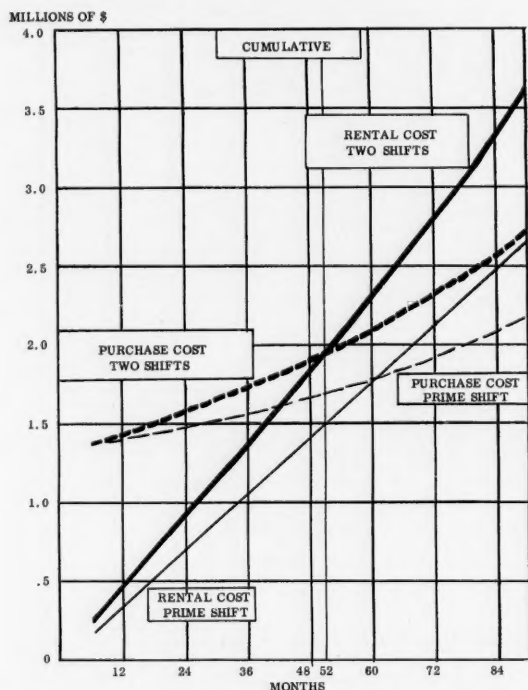


Figure 1—Computer Economics—Purchase vs. Rental

These cumulative costs, by period, have been plotted on a graph (see Figure 1) to indicate the break-even point of the two methods when used to compare a large transistorized computer, and to analyze the effect of a second shift on these break-even points. A projection of these costs beyond the intersections indicates the anticipated savings that can be realized by purchase of the equipment for various estimated years of useful life.

#### Assumptions

Certain assumptions have been made in the underlying calculations. They are:

1. *Interest*—5% interest has been computed semiannually and added to the cost of purchasing to the extent that these cumulative costs exceed the cumulative costs of renting. Conversely after the point at which total rentals exceed total purchasing costs, interest has been added to the cost of renting. The interest factor can

be viewed as a charge for borrowing or the value of committed funds if the machine were purchased with working capital.

2. *Depreciation*—An accelerated "sum-of-the-digits" method has been used, assuming an eight year life for all equipment with no scrap or salvage values. Until a market appears for used computers we believe it is prudent to ignore resale value.
3. *Insurance*—Fire and extended coverage insurance has been included as a cost of purchasing. A rate of 16¢ per \$100 of valuation has been used.
4. *Maintenance contracts*—We have assumed that service on purchased units is provided by the manufacturer under its maintenance contract at a cost as shown in published schedules.
5. *Federal corporate income tax*—To the extent that Federal taxes are reduced through the additional costs associated with purchasing, this amount has been added to the cost of renting. When yearly rental charges exceed the total costs applicable to purchasing, the tax savings have been added to the cost of purchasing. The Federal corporate income tax has been computed at an arbitrary 50%.

#### Financial Attractiveness of Purchase

The illustration emphasizes the financial attractiveness of purchasing an entire system and operating it on a two-shift basis for more than 52 months. While these curves do not exactly correspond to the actual out-of-pocket expenses, they do reflect the interactions of tax and interest factors and point to the relative merits of lease or purchase within the conditions stated. If a higher value were placed upon the earning power of capital, then the break-point moves to the right signifying the added contribution of cash freed through rental and the declining importance of tying up funds to support this purpose.

This technique has been applied to a variety of computers. The break-even point, for two shift operations, ranges from four years to five years with a central tendency about the middle of the fourth year. It is interesting to observe the effect of a purchase option on these calculations. Typically, the deciding line in favor of deferred purchase of a complete system, will shift to the right by the matter of just a few months.

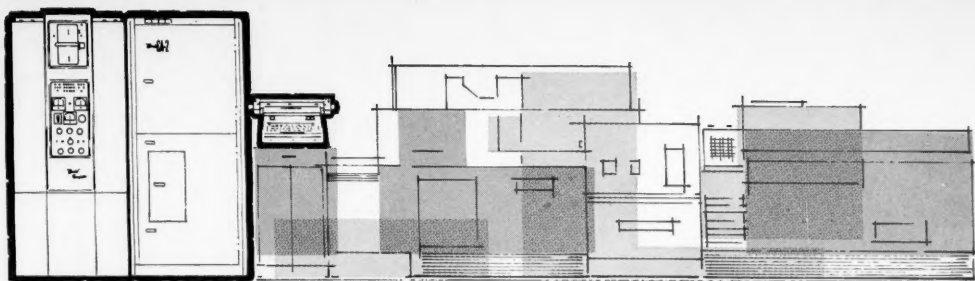
#### Why Rentals?

Having completed this exercise one can well ask the question: Why are not more companies purchasing? We can only speculate because the actual motives are seldom made public. Having rationalized that obsolescence could not be the compelling factor, then it must be that managements are viewing alternative investment opportunities as more profitable than ownership of a computer. If we assume that the operating savings attributable to the machine will pay the rent, then the purchase decision is one of how much more saving results when the equipment is acquired outright. This amount has to be at least as attractive as the yield promised by investing the same amount in plant, advertising or equivalent.

This is no different from using a larger interest factor in the break-even analysis. The break-point moves to the right and purchase becomes relatively less interesting.

The issue can never be resolved with finality when approached in general terms, but the experiences and the thinking of managements who have been through it will provide an ever broadening basis for guiding the actions of those who have not.





PRICE: LESS THAN 1/2 THAT OF ANY EQUIVALENT SYSTEM!

....THE BENDIX G-15  
IS THE LOWEST-COST  
PUNCHED CARD COMPUTER  
YOU CAN RENT OR BUY

By adding the Bendix Punched Card Coupler to the basic G-15, you have full alphanumeric punched card capabilities combined with the G-15's powerful computing ability. Price: less than 1/2 that of any equivalent system. The Punched Card Coupler allows the G-15 to use seven standard models of card readers, punches, and accounting machines. Up to three may be connected on-line at one time, and all input-output is fully buffered. And with the G-15, as standard equipment, you have a fully alphanumeric typewriter, a paper tape punch, and a searchable high-speed photo-electric paper tape reader. Low-cost magnetic tape units are also available. The great versatility of this business-scientific system, at such a remarkably low price, is setting new standards of computing economy.

Write for details.



DIVISION OF BENDIX AVIATION CORPORATION

LOS ANGELES 45, CALIFORNIA  
DEPARTMENT D-18

# Survey of Commercial Computers

## Part 2

Neil Macdonald  
Assistant Editor  
Computers and Automation

(Continued from the January, 1960 issue of *Computers and Automation*, vol. 9, no. 1, p. 22).

IBM 1401 Data Processing System / scientific, business / NUM SYS: variable no. alphanumeric char per mach word; 5 bits per char / RPD MEM: 1400, 2000, or 4000 positions; 12 us access / SLOW MEM: 1 to 6 magnetic tape units / ADN: 0.31 ms / MULT: 2.4 ms / DIV: 4.1 us / PRGMG: 65 instruc; 15 library routines in process / IN-OUT: in, 13 80-col cards per sec; out, 4 80-col cards per sec; 10 lines per sec, 100 or 152 char per line; simultaneous calculating / RELIAB: has autom checking / sale, \$125,600 to \$271,400 and up; rent, \$2475 to \$6750 and up / Available in several system configurations / IBM Corporation, 112 E. Post Rd., White Plains, N.Y. / \*C 59

IBM 7070 Data Processing System / scientific, business / NUM SYS: 10 char per mach word; 5 bits per char / RPD MEM: 5000 to 9990 reg, 10 digit words; 6 us access / ADN: 60 to 96 us / MULT: 780 us / DIV: 2112 us / PRGMG: 125 instruc; 35 library routines / IN-OUT: 25,000 to 50,000 mach words per sec; simultaneous calculating / RELIAB: has autom checking / sale, \$546,700 and up; rental, \$11,950 and up / IBM Corporation, 112 E. Post Rd., White Plains, N.Y. / \*C 59

IBM 7090 Data Processing System / scientific, real-time, business, etc. / NUM SYS: 10 char per mach word, 36 bits per word / RPD MEM: 32,768 reg; 2.4 us access / SLOW MEM: 80 tapes / ADN: 4.8 us / MULT: 4.8 to 33.6 us / DIV: 7.2 to 33.6 us / PRGMG: over 200 instruc, 750 library routines / IN-OUT: 10,400 mach words per sec; simultaneous calculating / RELIAB: has autom checking / sale, \$2,590,000 and up; rent, \$58,300 and up / IBM Corporation, 112 E. Post Rd., White Plains, N.Y. / \*C 59

IBM RAMAC 305 / business / NUM SYS: 100 char or less per mach word (various choices); 7 bits per char / RPD MEM: 100 position core memory, non-addressable, for internal switching / SLOW MEM: 2800 positions drum storage, 5 million positions of disk storage (20 million max) / ADN: 30 ms / MULT: 60 to 190 ms / DIV: 100 to 370 ms / PRGMG: 17 instruc, 30 library routines / IN: 2 cards per sec; / OUT: 1-2/3 cards per sec; 2-1/2 lines per sec (of 100 positions); simultaneous calculating / RELIAB: partial autom checking / sale, \$167,850 to \$584,000; rent, \$2,850 to \$11,120 / Mach is designed to permit "in-line" processing. Input may be combn of punched cards, paper tape, and manual keyboard. Output may be punched cards or printed on three models of printers ranging from 10 char per sec to 2-1/2 lines per sec. Two independent systems can be interconnected through common disk

storage units / IBM Corporation, 112 E. Post Rd., White Plains, N.Y. / \*C 59

Libratrol 500 / real-time, industrial process control / NUM SYS: 31 bits per char / RPD MEM: 1 reg, 250 us access / ADN: 250 us / MULT: 15 ms / DIV: 15 ms / PRGMG: 20 instruc, 50 library routines / IN-OUT: 75 mach words per sec, simultaneous calculating / RELIAB: autom checking; operg ratio 98% + / sale, \$84,500 to \$150,000 / sold or rented, 1 / Librascope, Inc., Burbank Div., 40 E. Verdugo Ave., Burbank, Calif. / \*C 59

MOBIDIC / scientific, real-time, business / NUM SYS: 36 bits per mach word, binary machine, with 6 bits per char for alpha-numeric / RPD MEM: 4,096 words expandable to 28,672; 8 us access / SLOW MEM: any practicable number / ADN: 16 us / MULT: 86 us / DIV: 88 us / PRGMG: 53 instruc, 24 library routines / IN-OUT: simultaneous calculating / RELIAB: has automatic checking; operg ratio, in production testing / sale, \$1,500,000 to \$2,500,000; rent, \$30,000 to \$50,000 / on order, 4 / Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N.Y. / \*C 59

MONROBOT IX / business / NUM SYS: 18 char or 64 bits per word / SLOW MEM: 14 reg (drum) / ADN: 2.5 ms (ave access time, 10 ms) / MULT: 1.6 secs for a 5 digit multiplier / DIV: limited by typewriter to 12 digits per sec / PRGMG: 15 instruc / IN: manual; OUT: 12 char per sec; no simultaneous calculating / RELIAB: no autom checking; operg ratio, 97.5% / sale, \$9,650; rent, \$250.61 per mo (5 years) / sold or rented, 25; on order, 30 / Monroe Calculating Machine Co., Inc., Orange, N.J. / \*C 59

NCR 304 / scientific, business / NUM SYS: 10 char per mach word; 6 bits per char / RPD MEM: 2400 to 4800 words; 60 us access / SLOW MEM: 850,000 words per tape / ADN: 180 us / MULT: 1140 us / DIV: 1320 us / PRGMG: 120 instruc; comprehensive set of library routines / IN-OUT: 6600 words per sec; no simultaneous calculating / RELIAB: has autom checking; operg ratio, "high" / sale, \$657,700 to \$1,380,000; rental, \$15,800 to \$32,000 / on order, 15 / The National Cash Register Company, Dayton 9, Ohio / \*C 59

Pegasus / scientific, business / NUM SYS: 39 binary digits / RPD MEM: 55 reg (magnetostrictive delay lines), access time zero / SLOW MEM: 4608 reg (magnetic drum), magnetic tape optional / ADN: 315 us / MULT: 2 ms / DIV: 5.5 ms / PRGMG: 4000 instruc, "extensive" library of routines / IN: 200 char per sec, OUT: 25 char per sec; no simultaneous

calculating / RELIAB: has autom checking, operg ratio 97.6% / sale, \$200,000 to \$250,000 / 22 installed; on order, not available / Ferranti Electric, Inc., 95 Madison Ave., Hempstead, N.Y. / \*C 58

RCA 501 Electronic Data Processing System / business / NUM SYS: unlimited char per mach word; 7 bit per char / RPD MEM: 16,384 to 262,144 char locations; 15 us access / SLOW MEM: 63 magn tape stations / ADN: 0.24 to 0.42 ms / MULT: 1.9 to 9.6 ms / DIV: 1.3 to 2.4 ms / PRGMG: 49 instruc / IN-OUT: 33,333 char per sec (magn tape); 1,000 char per sec (paper tape) / RELIAB: has autom checking / sale, \$556,300 to \$2,000,000 and up; rent, \$11,300 to \$40,000 and up / Radio Corporation of America, Industrial Electronic Products, Camden 2, N.J. / \*C 58

RECOMP II / scientific; not real-time / NUM SYS: 39 bits plus sign; 12.5 decimal digits, or 8 alphanumeric char per mach word / RPD MEM: two 8 word recirculating loops; 0.95 ms access / ADN: fixed point, 0.54 ms; floating point 1.35 ms / MULT: fixed point, 10.8 ms; floating point, 12.4 ms / DIV: fixed point, 11.3 ms; floating point, 12.7 ms / PRGMG: 49 instruc; 100 library routines / IN-OUT: 400 char or 50 mach words per sec; no simultaneous calculating / RELIAB: has automatic checking; operg ratio, 99% / sale, \$95,000; rent, \$3,000 / sold or rented, 20; on order, 10 / Autonetics, a Div. of No. American Aviation, Inc., Industrial Products, 3584 Wilshire Blvd., Los Angeles 5, Calif. / \*C 59

Royal Precision LGP-30 / scientific, business / NUM SYS: 5 alphanumeric char or 9 dec digits plus sign per mach word; 4 bits per digit, 6 bits per alphanumeric char / RPD MEM: drum, 4096 wds; 8 ms ave access / ADN: 2.25 ms / MULT: 17 ms / DIV: 17 ms / PRGMG: 16 instruc; many library routines / IN-OUT: 8 mach words per sec; no simultaneous calculating / RELIAB: no autom checking / sale, \$49,500; rent, \$1,100 / sold or rented, 320; on order, 34 / Royal McBee Corporation, Westchester Ave., Port Chester, N.Y. / \*C 59

RW-300 Digital Control Computer / real-time; scientific when "off-line" / NUM SYS: 3 alphanumeric char per mach word; 18 bits per mach word / RPD MEM: (mag drum) 7936 word general storage, 8.3 ms access; 16 word rapid access revolver, 1.04 ms access / SLOW MEM: tape, 8,300,000 word storage on 8 transports; max transfer rate, 2560 words per sec / ADN: 910 us / MULT: 1040 to 2990 us / DIV: 1170 to 3120 us / PRGMG: 20 instruc, 50 library routines / IN-OUT: paper tape, 20 mach words per sec; mag tape, 2540 mach words per sec; simultaneous calculating / RELIAB: no autom checking; operg ratio 99.5% / sale, \$100,000 to \$350,000; rent, \$4,000 to \$11,000 / sold or rented, 6; on order, 10 / The Thompson-Ramo-Wooldridge Products Company, 202 No. Canon Drive, Beverly Hills, Calif. / \*C 59

TRANSAC S-2000 (all transistor, data procg sys) / for scientific and business problems, also airborne computer uses / NUM SYS: binary, 48 bits per mach word; alphanumeric, 6 bits per char / RPD MEM: up to 32,768 words core storage, up to 32 index registers; magn drum, 32,768 words per drum; up to 256 drums per sys / ADN: 18 us (fixed point), 27.5 (floating

point) / MULT: 65 us (fixed), 51.0 us (floating) / DIV: 65 us (fixed), 51 us (floating) / PRGMG: 226 instruc / IN-OUT: 45,000 mach wds per sec, simultaneous calculating / RELIAB: has autom checking; operg ratio 98.6% / sale, \$1,100,000 and up; rent, \$25,000 and up / first delivery Oct. 1958 / Philco Corp., Government & Industrial Div., 4700 Wisahickon Ave., Philadelphia 44, Pa. / \*C 58

TRICE / for scientific problems; real-time "incremental computer" / NUM SYS: 30 char per mach word, 1 bit per char / ADN: 10 us / MULT: 10 us / DIV: 10 us / IN-OUT: simultaneous calculating / Packard Bell Computer Corp., 1905 Armco Ave., Los Angeles 25, Calif. / \*C 58

Univac II / for scientific and business problems; large volume input-output / NUM SYS: 12 alphanumeric char per mach word, each char 6 bits plus check bit / RPD MEM: 2000 reg; 20.2 us access / SLOW MEM: 16 magn tape units / ADN: 440 us / MULT: 2140 us ave / DIV: 3940 us ave / PRGMG: 76 instruc; several hundred library routines, including many automatic coding systems / IN-OUT: 25,000 char per sec; simultaneous calculating / RELIAB: has autom checking; operg ratio, over 95% / sale, approx \$1,500,000; rent, approx \$27,000 / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / \*C 59

UNIVAC File Computer / for real-time, business, and random inquiry operation / NUM SYS: 12 char per mach word; 64 check bits per char / RPD MEM: 4 reg, 12 char each (core); 2 buffers, 12 char each (core); 1 hi spd drum, approx 1000 12-char words

## COMPUTER PROGRAMMERS-ANALYSTS

Broadview Research Corporation is seeking computer programmers and applications analysts to work in the areas of scientific calculations, systems programming, and commercial data processing.

Company experience includes: satellite orbit computations, numerical solution of differential equations, simulation of communication systems, application of data processing techniques in the areas of logistics, personnel, and administration.

Qualifications: programming experience with medium-large scale computer systems.

Openings exist at Burlingame, California, Alamogordo, New Mexico, and Fort Huachuca, Arizona.

Contact: Mr. William J. Petersen

### Broadview Research Corporation

1811 Trousdale Drive  
Burlingame, California

# PROJECT 70,000,000

*Independent tests\* prove  
there are no copies "just as good"  
as CLARE Type J RELAYS*

**CLARE RELAYS** 70,000,000 Operations  
(8 Form C) No Contact Failures

**BRAND X1** 60,000,000 Operations  
(8 Form C) 11 Contact Failures

**BRAND X2** 40,000,000 Operations  
(8 Form C) 12 Contact Failures

**BRAND X3** 30,000,000 Operations  
(8 Form C) 8 Contact Failures

**BRAND X4** 20,000,000 Operations  
(8 Form C) 12 Contact Failures

**BRAND X5** 15,000,000 Operations  
(6 Form C) 7 Contact Failures

**BRAND X6** 10,000,000 Operations  
(6 Form C) 11 Contact Failures

**BRAND X7** 5,000,000 Operations  
(8 Form C) 18 Contact Failures

\*Failure of 10% of the total contacts involved  
eliminated any group from the test. Additional data  
available on request.

**J** CLARE Type Relays, with their small size, twin contact design and superior performance, have long been first choice for applications where component failure is intolerable. Demand for these relays has resulted in many imitations represented to be "just as good."

Above are the results on an exhaustive test by an independent laboratory of CLARE Type J Relays and copies made by other well-known manufacturers. Tests of CLARE relays were discontinued at 70,000,000 cycles . . . with no contact failures. All other relay groups showed failure of 10% of contacts before end of 60,000,000 cycles (see graph). Some had 22% failure under 5,000,000 cycles.

Let us tell you more about this important test.  
Address: C. P. Clare & Co., 3101 Pratt Blvd.,  
Chicago 45, Illinois; In Canada: C. P. Clare  
Canada Limited, P.O. Box 134, Downsview,  
Ontario. Cable Address: CLARELAY.

**CLARE RELAYS**  
FIRST in the industrial field

and 2.5 ms access; 1 to 33 other drums, 180,000 char per drum, 17.0 ms access / SLOW MEM: 1 to 10 tape units, 2400 ft reels, 20,000 blockettes per reel, 120 char per blockette / ADN: 9.5 ms (& check) / MULT: 21 ms ave / DIV: 30 ms ave / PRGMG: 48 external plugboard, 26 internal instruc / IN-OUT: 12,000 char per sec, simultaneous calculating / RELIAB: has autom checking; operg ratio 95% / sale, — ; rent, \$10,000 to \$12,000 / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / \*C 59

UNIVAC LARC / for scientific and business problems; real time or not / NUM SYS: 12 char per machine word; 4 bits per char / RPD MEM: 99 reg, 1 us access; and 97,000 reg, 4 us access / SLOW MEM: 6,000,000 reg (drum), 40 magnetic tape units / ADN: 4 us / MULT: 8 us / DIV: 32 us / PRGMG: 79 instruc / IN-OUT: 30,833 mach words per second; simultaneous calculating / RELIAB: has automatic checking; wherever possible, correction made without operator intervention / sale, approx \$6,000,000 and up; rent, \$135,000 and up / Remington Rand Univac, 315 Fourth Ave., New York 10, N.Y. / \*C 59

Univac Scientific Computing System, Model 1103A / for scientific and real-time problems; operations research / NUM SYS: 36 bits or 6 alpha-numeric char per mach word; 6 bits per char / RPD MEM: 28,672 reg of 36 bit words; 8 us access (cores), 32 us access (drum) / SLOW MEM: 320,000 reg of 36 bit words / ADN: 26 us / MULT: 112 us / DIV: 470 us / PRGMG: 50 instruc; several hundred library routines, including English language programs / IN-OUT: 2530 36-bit words per sec; no simultaneous calculating / RELIAB: no autom checking; operg ratio 99% / sale, \$922,000 to \$1,213,000; rent, \$21,560 to \$34,500 / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / \*C 59

Univac Scientific, Model 1105 / for scientific, real-time, and business problems; operations research / NUM SYS: 36 bits or 6 alpha-numeric char per mach word; 6 bits per char / RPD MEM: 28,672 reg of 36-bit words; 8 us access (cores), 32 us access (drum), after initial access / SLOW MEM: 720,000 reg of 36-bit words / ADN: 26 us / MULT: 112 us / DIV: 470 us / PRGMG: 50 instruc; over several hundred library routines / IN-OUT: 3333 36-bit words per sec; simultaneous calculating / RELIAB: no autom checking / sale, \$1,612,000 to \$1,850,000; rent, \$33,060 to \$48,000 / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / \*C 59

UNIVAC SOLID STATE / for scientific and business problems; not real-time / NUM SYS: 10 char per mach word; 4 bits per char / RPD MEM: 5000 reg; 17 us min, 1700 us ave access / SLOW MEM: 10 tape units / ADN: 85 us / MULT: 835 us ave / DIV: 986 us ave / PRGMG: 48 instruc / IN: via cards 133 words per sec; OUT: via cards 50 per sec; IN-OUT: via tape 1500 per sec; simultaneous calculating / RELIAB: has autom checking; operg ratio 96% / sale, \$298,155 to \$605,000; rent, \$5965 to \$12,600 / sold, about 50; on order, 200 plus / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / \*C 59



## WHO'S WHO IN THE COMPUTER FIELD

From time to time we bring up to date our "Who's Who in the Computer Field." We are currently asking all computer people to fill in the following Who's Who Entry Form, and send it to us for their free listing in the Who's Who that we publish from time to time in **Computers and Automation**. We are often asked questions about computer people—and if we have up to date information in our file, we can answer those questions.

If you are interested in the computer field, please fill in and send us the following Who's Who Entry Form (to avoid tearing the magazine, the form may be copied on any piece of paper).

Name? (please print) .....

Your Address? .....

Your Organization? .....

Its Address? .....

Your Title? .....

Your Main Computer Interests?

- ☐ Applications
- ☐ Business
- ☐ Construction
- ☐ Design
- ☐ Electronics
- ☐ Logic
- ☐ Mathematics
- ☐ Programming
- ☐ Sales
- ☐ Other (specify): .....

Year of birth? .....

College or last school? .....

Year entered the computer field? .....

Occupation? .....

Anything else? (publications, distinctions, etc.) .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

When you have filled in this entry form please send it to: Who's Who Editor, **Computers and Automation**, 815 Washington Street, Newtonville 60, Mass.

# COMPUTER ANALYSTS

*To design  
systems and  
develop  
techniques for  
semiconductor  
reliability  
studies*

The explosive expansion now underway in the semiconductor industry has called forth an increasing demand for reliability data. As a computer scientist, you can appreciate the problems and opportunities this creates in the area of information retrieval.

These are the opportunities for truly creative work which await you as a computer analyst at General Electric.

Specifically, your responsibilities will involve the design of large file systems and the development of retrieval techniques for application in reliability studies on semiconductor devices.

You will work with General Electric's world-famous team of scientists and engineers, in the campus-like atmosphere of modern Electronics Park.

This is a chance for unlimited professional growth with a leader in the fastest-moving branch of the electronics industry.

•

To qualify, you should have a B.S. in mathematics or the physical sciences, at least two years experience in 704 or 709. A background in statistics is desirable but not essential. U. S. citizenship is not required.

Write in complete confidence to  
Mr. M. D. Chilcote, Division J20.

**GENERAL  ELECTRIC**

Semiconductor Products Dept.,  
Electronics Park, Syracuse, N. Y.

# A Survey of European Digital Computers

## Part I

Joseph L. F. De Kerf

Research Laboratories  
Gevaert Photo-Producten N.V.  
Mortsel, Belgium

### INTRODUCTION

About three years ago, E. S. Calhoun presented a paper at the Eastern Joint Computer Conference (New York, December 10-12, 1956) entitled "New Computer Developments Around the World." A reprint of this paper was published in *Computers and Automation* (Vol. 6, No. 2, p. 10).

Most of the developments in Europe, announced by E.S. Calhoun in his paper have been completed now. About fifty experimental digital machines have been constructed and about the same number of commercial types are marketed. Altogether, the total number of machines of pure European construction, installed or on order, is estimated to be about 2,000 (electronic calculating punches included). Only a few of them are large scale systems, but it must be considered that in Europe prices are more decisive than in the U.S. As a consequence, the interest is directed mainly to small and medium computers.

It is the purpose of this paper to give an up-to-date survey of European contributions to the design and construction of digital computers. Descriptions of experimental computers and monotypes are limited to the main characteristics. Commercial computers are described more thoroughly. The prices given are approximate. For convenience, they have been converted into U.S. dollars, but in most cases they are only valid for the country where the computer is constructed.

The survey is restricted to pure European constructions. The section devoted to British computers is to be considered as a completion of a previous paper, "A Survey of British

Digital Computers" (*Computers and Automation*, Vol. 9, No. 3, p. 25). Three of the described computers are copies of U.S. machines, manufactured in Europe under license. U.S. machines marketed by companies like IBM, Remington Rand and Burroughs are not included, even if they are constructed by their European branches or affiliations.

The author is indebted to the direction of the Gevaert Photo-Producten N.V., Mortsel, Belgium, who made this study possible. He wishes also to thank the institutes, universities, and manufacturers who checked the information given. Completeness is not claimed, and further comments are of course very welcome.

### AUSTRIA

Three experimental digital machines have been developed at the "Institut für Niederfrequenztechnik" of the University of Technology (Vienna).

The first, the URR 1 (Universal Relais-rechenmaschine), is a small binary relay calculator constructed for education purposes. The store has a capacity of 16 words (word length: 18 bits). Instructions are of the 3 address type. Control is by punched tape.

The second, the LRR 1 (Logistische Relais-rechenmaschine), is a logical relay calculator. It is a further development of a similar machine, constructed by Ferranti Ltd (United Kingdom). It analyses logical functions of up to seven variables.

The third, a transistorized magnetic core computer, was designed in 1955 and has been completed in 1958. 5,000 germanium diodes and 3,000 transistors have been used. Its name, Mailüfterl, is derived from a mild Austrian spring-time wind (as contrasted with Whirlwind, etc.). Operation mode: serial parallel. Number base: binary decimal. Word length: 10 decimals (plus sign and operational digit). Point working: fixed. Instructions: 1 address type (1 word). Computing store: magnetic cores. Capacity: 50 words. Main store: magnetic drum. Capacity: 10,000 words. Speed: 3,000 rpm. Input/output: punched

tape and teletype writer. Multiplication time: 26 ms (by subroutine).

More details about Mailüfterl may be found in the Comm. of the ACM (Vol. 1, Nr. 2, p. 30). The computer is used at the Institute for research purposes. No commercial computer is manufactured in Austria.

### BELGIUM

At the initiative of the IRSIA (Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture) and of the FNRS (Fonds National de la Recherche Scientifique), the Bell Telephone Mfg. Co. (Antwerp) started in 1951 with the design of an experimental electronic digital computer. It was completed in 1954 and is now used by the CECE (Centre d'Etude et d'Exploitation des Calculatrices Electroniques) at Brussels.

Operation mode: serial parallel. Number base: binary decimal. Word length: 18 decimals. Point working: fixed and floating. Instructions: 1 address type (1 halfword). Store: magnetic drum. Speed: 4,200 rpm. Auxiliary store: magnetic tape units with a capacity of 5,000 words each. Input/output: electric typewriter. Multiplication time: 16 ms.

No commercial computer is manufactured in Belgium. Closed loop magnetic tape units, with 5 or 10 reels of 10 meter each (1 inch tape), are constructed and marketed by Bell Telephone Mfg. Co. Such units are used by Standard Telephones and Cables Ltd (United Kingdom), for their Stantec-Zebra computer (cf. "A Survey of Digital Computers").

### CZECHOSLOVAKIA

Punched card equipment for accounting and scientific applications is manufactured and marketed by the firm Aritma (Prague). The equipment includes a relay calculating punch (100 cards per min). Several special purpose machines, e.g. a three-dimensional Fourier analysis calculator and a Fourier synthesis calculator (both used for structure calculations), have been developed and constructed in collaboration with the Institute of Mathematical Machines of the Academy of Sciences (Prague).

A relay computer with magnetic drum store has been described in the Proc. of the Int. Comp. Conf., held at Darmstadt in 1955 (Nachrichten-technische Fachberichte Band 4, Vieweg & Sohn, Braunschweig).

1956). The computer, designed at the above mentioned Institute, is called SAPO (Samocinny Pocatac). Completion was announced for 1956. It contains about 8,000 relays and 350 vacuum tubes. The tubes are used in the circuits of the drum store. Input and output is on standard punched card equipment of Aritma.

Operation mode: parallel. Number base: binary. Word length: 32 bits (including parity bit). Point working: floating. Instructions: 3 + 2 address type (2 words). Store: magnetic drum. Capacity: 1,024 words. Speed: 3,000 rpm. Input/output: punched cards. Operation time: 320 ms.

When a, b, c, d and e are the addresses in the 3 + 2 address type instructions, the result of the operation on the words of locations a and b is put into location c. When the result is non-negative, the next instruction is taken from locations d and d+1. When the result is negative, the next instruction is taken from location e and e+1.

## FRANCE

Apart from the I.B.P. (Institut Blaise Pascal) calculator, an experimental machine with a neon tube computing store and an auxiliary magnetic drum store, developed for own use and completed with collaboration of the Logabax Company, most contributions to the digital computer field come from industry.

Bull (Compagnie des Machines BULL, Avenue Gambetta 94, Paris) is the largest manufacturer of data processing equipment in Europe and the third largest in the world.

When F. Bull died in 1925, he left his patents to the Oslo Cancer Institute (Norway). Those patents concerned punched card machines and in 1931 they were taken over by J. Callies, founder of the Bull Company. At that time, the firm started with about 50 employees. At the present time however, the staff exceeds the 6,000 and more than 2,500 Bull punched card equipments have been installed. The punched cards are the same as those of IBM and BTM. The equipments are sold or rented. Service contracts are available with purchase of the machines. Several computer manufacturers make use of Bull machines as input/output devices and as peripheral equipment.

Several calculators are listed among the wide range of punched card machines manufactured by Bull. In 1951 Bull completed its first electronic calculator, the Gamma 3, controlled by panels or punched cards. Later on a magnetic drum store was added and the calculator was extended to a stored program computer. More than 600 Gamma's have been installed now and the prototype of a large electronic data processing system, the Gamma 60, has been completed recently. More than ten are on order and the first deliveries are expected in a few months (Oct. 1959). An automatic programming system for Gamma 60 was presented at the Int. Conf. on Inf. Proc. (UNESCO House, Paris, 15-20 June 1959).

— Bull: Gamma 3

Control: panel or program cards. Operation mode: serial. Number base: binary

decimal (8-4-2-1 code). Alphanumeric representation: 2 decimal positions. Word length: 12 decimals. Program (panel): 32-48-64-128 steps. When controlled by punched cards: up to 48 instructions per card (instruction length: 16 bits). Instructions: 1 address type.

Computing store: delay lines. Capacity: 4 to 7 words. Access time: 172 microsec. 3 extra units, each having a capacity of 8 words, may be added. Optional auxiliary store: magnetic drum. Capacity: up to 16,384 words (128 tracks of 128 words). Speed: 2,750 rpm. Average access time: 13.6 ms. Programs and subroutines may be stored on the magnetic drum and, when the calculator is provided with the drum, it is to be considered as a stored program computer. The maximum program capacity of the drum is 49,152 instructions. A quick access store unit, with a capacity of 64 words (8 blocks of 8 words), is added. It is used as buffer store between the computing store and magnetic drum or input/output units. This store unit may be increased to 128 words (16 blocks of 8 words).

Input/output (80-column punched card equipment): reproducers (120 or 240 cards per min in, 120 cards per min out) and tabulators (150 cards per min in, 150 lines per min out). Several combinations are possible (2 reproducers, or 1 reproducer and 1 tabulator, or 2 tabulators).

Operation speeds (access time to quick access store included): 0.2 ms for addition and subtraction, up to 21 ms for multiplication and division (11 ms average).

Power consumption: up to 6 kVA. Room accommodation required: 250 sq ft. Technical data: 280 kc/s prf, vacuum tubes (400 to 800), germanium diodes (between 5,000 and 18,000), delay lines (quantity depending on the size of the quick access store). Selling price: \$120,000 and up. Leased: \$2,500 and up.

— Bull: Gamma 60

Operation mode: parallel. Number base: binary decimal (8-4-2-1 code). Basic word unit (called catena): 24 pure binary bits or 6 decimal digits or 4 alphanumeric char. The arithmetic unit operates on two catena words. All other units operate on words of variable catena length. Point working: floating or programmed decimal. Floating point representation: 10 digit mantissa + 2 digit exponent. Programmed decimal point representation: 10 digit number + 2 digits for point specification. Instructions: 1, 2 or 3 address type. Instruction length: variable (1 or more catenae). All operations are internally checked.

Store: magnetic cores. Capacity: 1 to 8 blocks of 4,096 catenae (maximum capacity: 32,768 catenae). Access time: 10 microsec. Auxiliary store, magnetic drums. Capacity per drum: 25,600 catenae (128 tracks of 200 catenae). Speed: 3,000 rpm. Average access time: 10 ms. An unlimited number of magnetic tape units may be connected. Tape width: 1/2 inch. Tape length: 2,400 ft. Capacity: 1.2 or 1.8 million catenae. Read/write speed: 3,750 or 7,500 catenae per sec. The magnetic core store is used as central buffer between all the units. All operations may be performed simultaneously.

Input: 80-column punched card readers (300 cards per min) and 5-8 channel punched tape readers (200 char. per sec).

Output: 80-column card reader-punches (300 cards per min), 5-8 channel tape punches (25 char. per sec) and printers (300 lines of 120 char. per min). The reader-punches may be used for input and output. Any number of input and output units may be connected. A central data translator converts automatically the input/output code to and from the internal code and performs all editing operations.

Operation speeds (floating or programmed decimal): 0.1 ms for addition and subtraction, 0.25 ms for multiplication and 0.42 ms for division.

Power consumption (basic machine): 75 kVA. Room accommodation required: about 2,000 sq. ft. Technical data: 2,700 kc/s prf, vacuum tubes (400), germanium diodes (200,000), transistors (30,000), printed circuits on plug-in boards, magnetic cores. Selling price (basic machine): \$1,000,000 and up.

The S.E.A. (Société d'Electronique et d'Automatisme, Boulevard de Verdun 138, Courbevoie, Seine), founded in 1948 by F. H. Raymond, manufactures computers, flight simulators, numerical control systems, sound-powered telephones, etc.

Since 1950 the company has constructed several types of analog computers and special purpose digital calculators. The first general purpose digital computer, called CUBA (Calculatrice Universelle Binaire de l'Armement), was completed in 1954 for the Central Armour Laboratory of France. The first type of a commercial data processing system, the CAB 2000 series, was built in 1956. A magnetic core unit and a magnetic drum were used as computing and main store respectively. Later on, the possibility to connect magnetic tape units was developed. An expanded version, the CAB 3000 series, has been marketed in 1958. A medium size digital computer with magnetic core logical units (SYMMAG), the CAB 500, has been completed recently. A transistorized large scale computer, the CAB 5000 series, is under development. Both are designed for scientific calculations.

CAB is the abbreviation of "Calculatrice Universelle Arithmétique Binaire." The CAB 500 and 3030 are described below. The main characteristics of the CAB 5000 are: serial parallel operation mode, 40 bits word length, fixed and floating point working, 20,000 operations per sec, a 4,096 to 16,384 word magnetic core store, magnetic drums, magnetic tape units, etc. About ten CAB's have been installed or are on order (Sept. 1959).

— S.E.A.: CAB 500

Operation mode: serial. Number base: binary (conversion from and to decimal are automatic). Word length: 34 bits (sign and parity bit included). Point working: fixed (floating by microprogram). Instructions: 1 and 2 address type (1 word). Operation code: 1 or 2 function letters (13 elementary functions, 32 microprograms). Multiplication and division by microprogram. Number of registers: 16.

Quick access store: magnetic cores. Capacity: 16 words. Access time: 2.5 microsec. Main store: magnetic drum. Capacity: 16,384 words (128 tracks of 128 words). Half of the capacity is used for micropro-

grams and subroutines. Speed: 3,000 rpm. Average access time: 10 ms. A magnetic tape unit may be added. Capacity: 2.1 million char. (blocks of 160 char.). Read/write speed: 4,500 char. per sec. When connected the computer is called CAB 600.

Input/output: Flexowriter with punched tape (10 char. per sec). A punched tape reader (100 char. per sec), a tape punch (45 char. per sec) and a curve plotter are optional.

Operation speeds: 0.360 or 46 ms for addition and subtraction, 46 ms for multiplication and 92 ms for division.

Power consumption: 1.5 kVA. Floor area occupied: 28 sq. ft. Technical data: 200 kc/s prf, tyratrons (8), germanium diodes (300), transistors (250) and symmags (700). Price (CAB 500): \$60,000 (Flexowriter included). Not leased.

—S.E.A.: CAB 3030

Operation mode: serial. Number base: binary. Word length: 30 bits. Alphabetic representation: 6 bits per char. Point working: fixed. Instructions: 1 and 2 address type (1 word). Number of operations: 32 x 2. A high speed parallel multiplier is incorporated. An automatic square root extractor is optional. Number of registers: 4.

Store: magnetic cores. Capacity: 1,024 words (blocks of 128 words). Up to 16 units may be connected (total maximum capacity: 16,384 words). Access time: 10 microsec. Auxiliary store: magnetic drums. Capacity: 16,384 words (128 tracks of 128 words). Speed: 2,500 rpm. Average access time: 15 to 20 ms. Up to 32 magnetic tape units may be added. Tape width: 5/8 inch. Tape length: 750 m. Capacity: 2.15 million characters (in blocks of 160 char.). Read/write speed: 8,000 char. per sec. The magnetic tape units are connected with the computer through one or more sorter/collator units. Both functions may be performed while computing proceeds.

Input: 7 hole punched tape readers (200 or 400 char. per sec) and 80-column punched card readers (400 cards per min). Output: tape punches (50 char. per sec), line printers (Shepard 190: 900 lines of 120 to 190 char. per min), high speed microfilm printers (2,000 char. per sec) and curve plotters (4 simultaneous curves, 0.8 sec per point). Flexowriters may be added (10 char. per sec). Input/output units are linked directly to the magnetic tape decks by coordinating units. Up to 128 external units (magnetic tape decks included) may be interconnected.

Operation speeds (including access to computing store): 0.32 ms for addition and subtraction, 0.64 ms for multiplication and 11 ms for division.

Power consumption: 40 kVA. Floor area required: 110 sq. ft. Technical data: 100 kc/s prf, vacuum tubes (4,000), germanium diodes (40,000), printed circuit plug-in boards (2,600). Price: \$300,000 (Flexowriter, punched tape reader of 200 char. per sec and tape punch of 50 char. per sec included). Not leased.

A parallel operating magnetic core computer is developed by the S.N.E. Company

(Société Nouvelle d'Electronique, Avenue Kléber 45, Paris). The prototype is destined for the National Meteorological Institute. The commercial version, KL 901, will be marketed very soon.

—S.N.E.: KL 901

Operation mode: parallel. Number base: binary. Word length: 29 or 30 bits (parity bit). Point working: floating. Floating point representation: 23 bit mantissa + 5 bit exponent. Instructions: 1 address type (1 word). Number of operations: 64. Number of registers: 9 (2 index registers).

Store: magnetic cores. Capacity: 8 blocks of 1,024 words. Access time: 5 microsec. Up to 8 magnetic tape units may be connected. Tape width: 2 1/4 inch. Tape length: 750 m. Capacity: 6 million words per reel. Speed: 10,000 words per sec. Bilateral transfer between fast access store and tape units while computing proceeds.

Input/output: punched tape (input speed: 1,000 char. per sec).

Operation speeds (access time included): 10 to 25 microsec for addition and subtraction, 25 to 135 microsec for multiplication and 250 microsec average for division.

Power consumption: 50 kVA. Room accommodation required: 1,350 sq. ft. Technical data: 200 kc/s prf, vacuum tubes (10,000), germanium diodes (15,000), transistors (200), magnetic cores (3,000 logic cores plus store) and printed circuits on plug-in boards. Price (magnetic tape units not included): about \$800,000. Not leased.

Finally, the Intertechnique Company (Avenue de Paris 94, Versailles, Seine et Oise), licensed by the Thompson-Ramo-Wooldridge Company, will manufacture and sell a copy of the well-known RW-300 digital process control computer. Four machines are ordered by the two first commercial nuclear power plants of France. Two of them are installed now (Oct. 1959). Another is ordered by a French petroleum company. These computers will be used for closed-loop control.

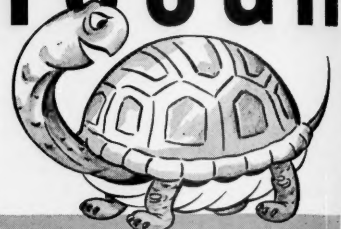
—Intertechnique: RW-300

Operation mode: serial. Number base: binary. Word length: 18 bits (sign included). Point working: fixed. Instructions: 1 + 1 address type (2 words). Number of operations in the instructing code: 19 (more than 150 operations).

Store: magnetic drum. Capacity: 7,936 words (62 tracks of 128 words). Speed: 3,000 rpm. Average access time: 10 ms. An additional track is used as quick access circulating store (16 words with 1.25 ms access time per word). Another track is used for a loading program.

[To be continued in the March issue of Computers and Automation]

# TOUGH



## ... AS A TURTLE'S BACK



### ARMAG\*-PROTECTED DYNACOR® BOBBIN CORES AT NO EXTRA COST!

Tough-as-tortoise-shell Armag armor is an exclusive Dynacor development. It is a thin, non-metallic laminated jacket for bobbin cores that replaces the defects of nylon materials and polyester tape with very definite advantages—and, you pay no premium for Armag extra protection.

Tough Armag is suitable for use with normal encapsulation techniques on both ceramic and stainless steel bobbins. It withstands 180°C without deterioration—is completely compatible with poured potted compounds—has no abrasive effect on copper wire during winding—fabricates easily to close-tolerance dimensions—inner layer is compressible to assure tight fit on bobbin—does not shrink, age or discolor.

Write for Engineering Bulletins DN 1500, DN 1000A, DN 1003 for complete performance and specification data covering the wide range of Dynacor low cost Standard, Special and Custom Bobbin Cores—all available with Armag non-metallic armor.

\*TRADEMARK

# DYNACOR

**DYNACOR, INC.**  
A SUBSIDIARY OF SPRAGUE ELECTRIC CO.  
1014 Westmore Avenue, Rockville, Maryland



# SURVEY OF RECENT ARTICLES

Moses M. Berlin  
Cambridge, Mass.

We publish here a survey of articles related to computers and data processors, and their applications and implications, occurring in certain magazines. We seek to cover at least the following magazines:

Automatic Control  
Automation  
Automation and Automatic  
Equipment News (British)  
Business Week  
Control Engineering  
Datamation  
Electronic Design  
Electronics  
Harvard Business Review  
Industrial Research  
Instruments and Control  
Systems  
ISA Journal  
Proceedings of the IRE  
The Office  
Scientific American

The purpose of this type of reference information is to help anybody interested in computers find articles of particular relation to this field in these magazines.

For each article, we shall publish: the title of the article / the name of the author(s) / the magazine and issue where it appears / the publisher's name and address / two or three sentences telling what the article is about.

The Competition is Murder in Computing Control / Control Engineering, vol. 6, no. 11, Nov., 1959, p 95 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N.Y.

A brief report on computer control in 1959, and a prediction for 1960. Lists are given with information on sales during this year, with projected figures being included for the coming year. Mentioned by name are companies which have bought or plan to buy one or more of the computer systems listed.

Computer Revolution in the Library / ISA Journal, vol. 6, no. 10, Oct., 1959, p 43 / Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

COMPUTERS and AUTOMATION for February, 1960

## JOIN THE RCA BREAKTHROUGH IN ELECTRONIC DATA PROCESSING

RCA . . . world leader in electronics . . . is currently expanding its electronic data processing operations as a result of one of the most significant breakthroughs in modern electronics—the all-transistor RCA 501 system. Already the RCA 501 is being talked about as the world's most efficient electronic data processing system; its sales curve is slanting sharply upwards.

If you have experience in EDP sales or technical services, and are ready to step up to more challenging and rewarding assignments, investigate today the many new career openings at RCA. Current positions, dealing with medium and large-scale systems, include the following:

**EDP SALES REPRESENTATIVE**—background should include a thorough systems knowledge and at least one year of field experience with either government or commercial clients.

**EDP PROGRAMMERS AND METHODS ANALYSTS**—local openings for qualified men to work closely with both customer and sales personnel in the development of specific applications, related procedures, and programs.

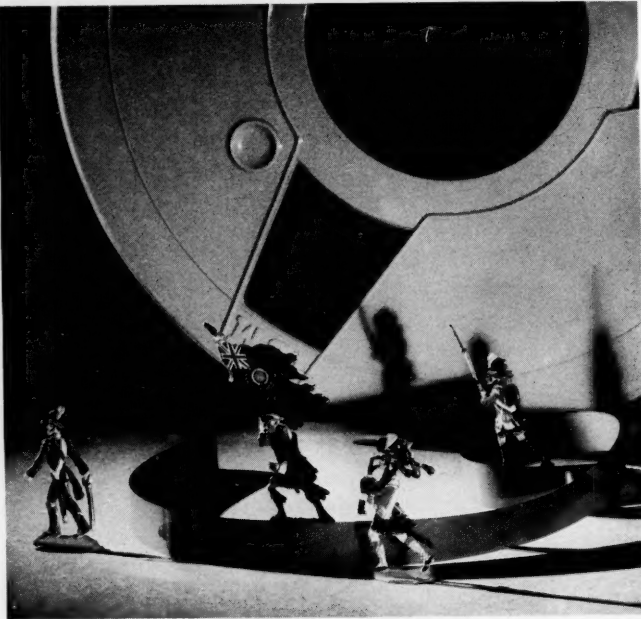
*For a strictly confidential interview with RCA management, please send a detailed résumé of your background and personal qualifications to:*

Mr. E. C. Baggett  
Professional & Administrative Employment  
RCA, Dept. CA-20  
Bldg. 10-1  
Camden 2, N. J.



**RADIO CORPORATION of AMERICA**

ELECTRONIC DATA PROCESSING DIVISION



## wanted: WAR GAME PLAYERS

Very large-scale air-battle digital computer simulations are now going on at the Washington Research Office of *tech/ops*. Present operations call for *top-flight mathematicians, mathematical statisticians, senior programmers, operations research analysts.*

These computer air battles are stochastic models which involve design and evaluation, and development of unusual techniques for studying sensitivity of these models to input changes. Associated activity involves design of advanced programming systems and of common language carriers which are expected to be independent of the first computer used—the computer itself augmenting and improving the language for use on later and more sophisticated computers.

If challenging work, stimulating atmosphere, and an opportunity to participate in an unusual company/employee investment program interest you . . . write or wire collect:

**tech/ops**

Kingsley S. Andersson

**Technical Operations, Incorporated**

3520 PROSPECT STREET, NORTHWEST • WASHINGTON 7, D. C.

\*the toy soldiers: officer and men of the 79th Foot Regiment, King's Own Scottish Light Infantry, in uniforms worn at the Battle of Waterloo (from the collection of a member, American Society of Military Historians and Collectors).

This article maintains that computers will be standard equipment in libraries of the future. Some points in support of this thesis: literature searching, indexing, and selecting can be accomplished rapidly, with an electronic control system. Moreover, the establishment of a world-wide scientific data processing center may soon be a reality.

**Computers and the Neon Lamp** / J. H. Thomas / *Radio-Electronics*, vol. 30, no. 11, Nov., 1959, p 111 / Gernsback Pub. Co., Inc., 154 West 14 St., New York 11, N.Y.

Neon lamps, a standard feature on computer consoles, can be used with computer circuitry, in various applications and operations. This article describes methods for making use of the lamps, giving specific applications.

**An Analog Computer for On-Line Reactor Control** / E. D. Tolin and D. A. Fluegel, Phillips Petroleum Co., Bartlesville, Oklahoma / *ISA Journal*, vol. 6, no. 10, Oct., 1959, p 32 / Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

By calculating reactor operating guides in real time, the analog computer effects an increase in production and production uniformity. The computer also "spots" erratic operation in any part of the system. The advanced process-instrument engineer will find this article highly informative.

**A Computer Census** / John Diebold / *Punched Card Data Processing*, vol. 1, no. 6, Sept.-Oct., 1959, p 22 / Gille Associates, Inc., 956 Maccabees Bldg., Detroit 2, Mich.

A chart is presented, which lists the number of computers on order and delivered by U.S. manufacturers. A brief explanation of "small-," "medium-," and "large-," scale, is given.

**Magnetic Tape Recorders for Industrial Control** / E. G. Wildanger, Mgr., Application Engineering, Ampex Corp., Redwood City, Calif. / *Automation*, vol. 6, no. 10, Oct., 1959, p 139 / Penton Pub. Co., Penton Bldg., Cleveland 13, Ohio

A discussion of the applicability of magnetic tape for computers and related uses. Among the advantages are: huge information capacity, preservation of data capabilities, memory, variable time delay. Some applications are mentioned. The article is an abstract of a paper, "Some Aspects of Magnetic Tape Recording Useful for Industrial Control."

**Golf Handicapping on a Computer** / William A. Gothard / *Punched Card Data Processing*, vol. 1, no. 6, Sept.-Oct., 1959, p 12 / Gille Associates, Inc., 956 Maccabees Bldg., Detroit 2, Mich.

An application of the computer to golf handicapping is described. The two methods used are discussed. It is argued that the computer is the most impartial handicapper in existence.

**U.S. to Use More Computers** / *Electronics*, vol. 32, no. 41, Oct. 9, 1959

computers  
libraries  
port of  
index-  
published  
ol sys-  
t of a  
rocessing

/ J. H.  
rol. 30,  
rnsback  
s, New

ure on  
d with  
applica-  
icle de-  
of the  
ns.

ine Re-  
d D. A.  
o., Barr-  
Journal,  
32 / In-  
13 Sixth

g guides  
er effects  
duction  
"spots"  
the sys-  
trument  
ighly in-

iebold /  
g, vol. 1,  
/ Gille-  
es Bldg.

lists the  
and de-  
A brief  
um," and

Industrial  
Mgr., Ap-  
ex Corp.,  
utomation,  
p 139 /  
dg., Cleve-

ability of  
and related  
are: huge  
on of data  
time de-  
mentioned  
f a paper,  
pe Record-  
trol."

computer /  
nched Cat-  
o. 6, Sept-  
Associates,  
Detroit 2

computer to  
d. The two  
It is argu-  
st impar-

ers / Ele-  
Oct. 9, 1959

bruary, 1960

p 39 / McGraw-Hill Pub. Co., Inc.,  
330 West 42 St., New York 36, N.Y.

There has been an increase in the number of computers being used by the Federal government, the number presently being 175. As additional government agencies realize savings through cost reduction by automatic control, and centralized activity in research projects under Federal auspices proceeds, computers will realize still wider applications.

**Evolution of Computer Controlled Power Generation / F. A. Ritchings and W. A. Summers, Ebasco Services, Inc., New York, N.Y. / Automation, vol. 6, no. 11, Nov., 1959, p 90 / Penton Pub. Co., Penton Bldg., Cleveland 13, Ohio**

The development of the control of generating plants is traced from the time of Edison, to the present, with various approaches that have been implemented. The modern approach includes automatic control with computer monitoring. A fascinating article.

**Computers and Automation in the Soviet Union / E. M. Grabbe, Senior Staff Consultant on Automation, Thompson Ramo Wooldridge Inc., Los Angeles, Calif. / Journal of Machine Accounting, vol. 10, no. 10, Oct., 1959, p 20 / National Machine Accountants Association, 720 Kensington Rd., Arlington Hts., Ill.**

A description of various computers designed and manufactured in the U.S. S.R. Comparisons with U.S.A. systems are given, and a chart lists characteristics of the Russian data processing systems.

**Checking Taped Instructions for Machine Tool Numerical Control Systems / V. Rogers, Boeing Airplane Co., Wichita Div. / Control Engineering, vol. 10, no. 10, Oct., 1959, p 103 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N.Y.**

An automatic system to check tapes on which control data has been recorded, which doesn't necessitate producing a particular part, thereby eliminating waste if the tape is faulty. The system involves magnetic tape verification by a combination of an oscillograph, oscilloscope, a square wave generator and a conventional 4-watt audio amplifier and speaker.

**Shorthand for Computers / R. L. Martin, Remington Rand Co. / Journal of Machine Accounting, vol. 10, no. 10, Oct., 1959, p 47 / NMAA, 720 Kensington Rd., Arlington Hts., Ill.**

A thorough discussion of programming, including the development of systematic coding and the procedures leading up to the final program. The article gives a description of compilers, and explains their functions.

**Automation Needs a Human Policy / J. Diebold / Challenge, May, 1959, pp 42-6 / Challenge, New York University, Institute of Economic Affairs, 475 Fifth Ave., New York 17, N.Y.**

This article discusses some of the economic problems management will encounter and must solve, with the imple-

mentation of automation. Among the problems: consideration to such matters as dismissal pay to individuals whose specific jobs are eliminated; how the benefits of automation should be divided.

**Steps in Achieving Control of Material on an Electric Computer / H. W. White, Lockheed Aircraft Corp., Burbank, Calif. / N.A.A. Bulletin, vol. 40, no. 10, June, 1959, pp 51-60 / N.A.A. Bulletin, 505 Park Ave., New York 22, N.Y.**

An aircraft company uses a computer to produce documents pointing out specific inventory items which need attention. This article discusses inputs used in the system, and lists five steps for any system's input. The computer's output is described and its uses, enumerated.

**Magnetic Tape Pays A. T. & T. Dividends / Management and Business Automation, May, 1959, pp 14-17, 32-35 / M. & B. A., 600 West Jackson Blvd., Chicago 6, Ill.**

Transfer of stock and bond division records on magnetic tape, are processed by computer. The system provides accuracy and handles large volume activities, i.e., a recent stock split. Input, output and operation are described and discussed.

**Automatic Systems Testing / G. B. Way and M. Rubin, Computers and Controls Engineering, Autonetics, Div. of North American Aviation Inc. / Automation, vol. 6, no. 9, Sept., 1959, p 73 / Penton Pub. Co., Penton Bldg., Cleveland 13, Ohio**

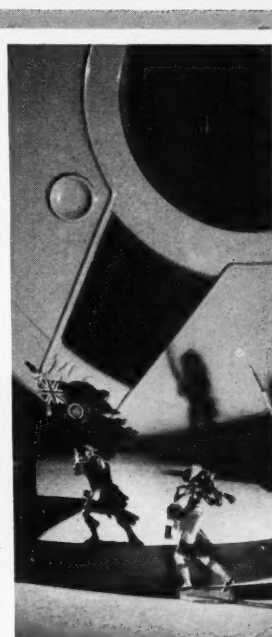
This article presents a number of techniques for automatically testing systems composed of electronic, pneumatic, hydraulic and mechanical components. The functioning of various components, and step-by-step testing techniques are described. Diagrams accompany each description, and in some testing methods, data processing is used.

**The 180° Turn / L. H. Matthies, Ross-Martin Co., Tulsa, Okla. / The Office, vol. 50, no. 5, Nov., 1959, p 142 / Office Publications, Inc., 232 Madison Ave., New York 16, N.Y.**

The turn in the attitude of business management towards the systems specialist, is the subject of this brief report on the wide application of data processing in the past ten years. Errors on the part of management in lack of attention to systems work are discussed, suggestions for more efficient use of computers are made.

**Selection of Computer Personnel / R. M. Paine / The Computer Bulletin, vol. 3, no. 2, Aug.-Sept., 1959, p 23 / British Computer Society Ltd., Finsbury Court, Finsbury Pavement, London, E. C. 2, England**

The success of a computer system depends to a large degree, upon the people running the system. This article discusses various methods of organizing qualified computer personnel; it covers training, aptitude, salary, and interview techniques.



## and at tech/ops' Monterey

Research Office, in California, an unusual opportunity exists for a mathematician-programmer to expand his horizons in mathematical analysis and computer programming, in an operations research environment. A B.S. degree and one to two years' programming experience are required, plus the desire and ability to contribute to pre-programming analysis. The over-all Company policies in areas of fringe benefits and profit-sharing plans are unique. Write or wire collect:

**Harold E. Kren  
Technical  
Operations,  
Incorporated**

**tech/ops**

**305 WEBSTER STREET  
MONTEREY, CALIFORNIA**

\*the toy soldiers: officer and men of the 79th Foot Regiment, King's Own Scottish Light Infantry, in uniforms worn at the Battle of Waterloo (from the collection of a member, American Society of Military Historians and Collectors).

## NEW PATENTS

RAYMOND R. SKOLNICK  
Reg. Patent Agent

Ford Inst. Co., Div. of Sperry Rand Corp.  
Long Island City 1, New York

THE following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the United States Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington 25, D.C., at a cost of 25 cents each.

September 22, 1959 (cont'd):

- 2,905,833 / William Miehle, Havertown, Pa. / Burroughs Corp., Detroit, Mich. / A circuit for performing the "Exclusive Or" logical function A or B but not A and B.
- 2,905,874 / Leroy U. C. Kelling, Waynesboro, Va. / General Electric Co., a corp. of N.Y. / A position control system and device.
- 2,905,875 / John E. Fielden, Sale, Eng. / Fielden Electronics Ltd., Manchester, Eng. / A motion transducing servo-system.
- 2,905,879 / James E. Starr, Detroit, Mich. / Control Devices, Inc., Detroit, Mich. / An electronic memory circuit.
- 2,905,930 / Daniel Golden, Bronx, N.Y. / Underwood Corp., New York, N.Y. / A data transfer system.
- 2,905,931 / Samuel Lubkin, Bayside, N.Y. / Underwood Corp., New York, N.Y. / A comparator for comparing data from first and second data sources.
- 2,905,933 / Michele Canepa, South Norwalk, Conn. / Olivetti Corp. of America, New York, N.Y. / A magnetic drum storage unit.
- 2,905,935 / Victor W. Bolie, Cedar Rapids, Iowa / Collins Radio Co., Cedar Rapids, Iowa / A decade to binary converter.
- Sept. 29, 1959: 2,906,455 / William P. Vafakos, Brooklyn, N.Y. / Sperry Rand Corp., a corp. of Del. / A computing mechanism for inverting the input function.
- 2,906,457 / Floyd G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / A difunction root extractor circuit.
- 2,906,459 / Clarence A. Lovell, Summit, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A quarter square electric voltage multiplier.
- 2,906,818 / Hunter C. Goodrich, Collingswood, N.J. / R.C.A., a corp. of Del. / A transistor phase detector circuit.
- 2,906,819 / Perrin F. Smith, Santa Clara County, Calif. / I.B.M. Corp., New York, N.Y. / A data reading machine.
- 2,906,887 / Jack L. Rosenfeld, Cambridge, Mass. / Bell Telephone Lab., Inc., New York, N.Y. / A magnetic core switching circuit.
- 2,906,889 / Raymond W. Emery, Poughkeepsie, and Robert A. Henle, Hyde Park, N.Y. / I.B.M. Corp., New York, N.Y. / A binary trigger circuit employing a single transistor.
- 2,906,892 / John Paul Jones, Jr., Pottstown, Pa. / Navigation Computer Corp., a corp. of Penn. / A shift register incorporating a delay circuit.
- 2,906,997 / Richard Rabin, Stamford, Conn., and Kurt Merl, Bronx, N.Y. / Sperry Rand Corp., a corp. of Del. / A high speed redundancy check generator.
- 2,907,000 / Joseph D. Lawrence, Jr., Phila., Pa. / Sperry Rand Corp., a corp. of Del. / A double base diode memory.
- 2,907,001 / Egon E. Loebner, Princeton, N.J. / R.C.A., a corp. of Del. / An information handling system.
- 2,907,002 / Joel N. Smith, Westmount, and William R. Ayres, Oaklyn, N.J. / R.C.A., a corp. of Del. / A message spacing control system.
- 2,907,003 / Linder C. Hobbs, Haddonfield, N.J. / R.C.A., a corp. of Del. / An information handling system.
- 2,907,004 / Kun Li Chien and Charles H. Propster, Jr., Haddonfield, N.J. / R.C.A., a corp. of Del. / A serial memory system.
- 2,907,005 / Kun Li Chien and Charles H. Propster, Jr., Haddonfield, N.J. / R.C.A., a corp. of Del. / A serial memory system.
- 2,907,006 / John P. Eckert, Jr., Phila., Pa. / Sperry Rand Corp., a corp. of Del. / A shifting register with inductive intermediate storage.
- October 6, 1959: 2,907,893 / John P. Eckert, Jr., Phila., Pa. / Sperry Rand Corp., a corp. of Del. / A delay flip device.
- 2,907,894 / Theodore H. Bonn, Phila., Pa. / Sperry Rand Corp., a corp. of Del. / A system of magnetic gating on core inputs.
- 2,907,895 / Adrianus von Overbeek, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N.Y. / A transistor trigger circuit.
- 2,907,896 / Roland Yui, Broomall, Pa. / Burroughs Corp., Detroit, Mich. / A pulse generating circuit.
- 2,907,898 / Edward G. Clark, Orelana, Pa. / Burroughs Corp., Detroit, Mich. / A transistor shift register.

## ADVERTISING INDEX

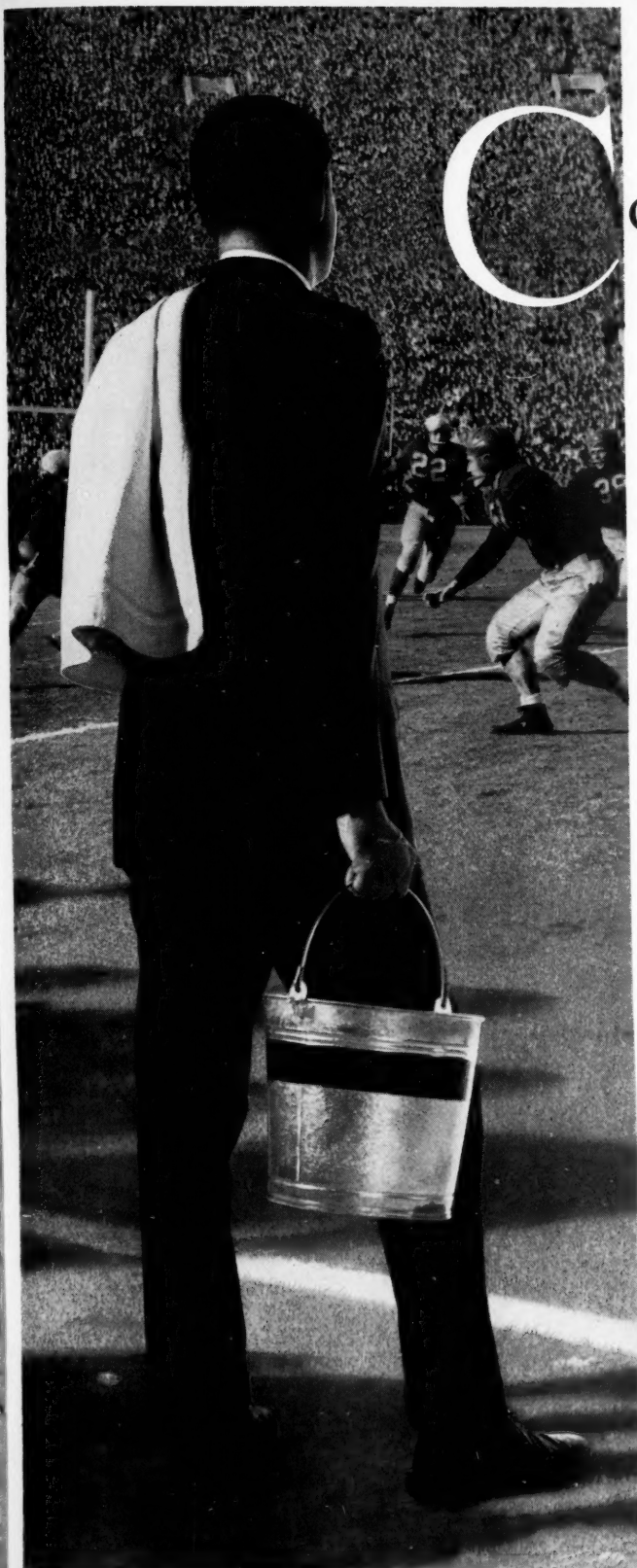
Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

- Arnold Engineering Co., Marengo, Ill. / Page 7 / Erwin Wasey, Ruthrauff & Ryan, Inc.
- Bendix Aviation Corp., Computer Div., 5630 Arbor Vitae St., Los Angeles, Calif. / Page 19 / Shaw Advertising, Inc.
- Broadview Research Corp., 1811 Trousdale Dr., Burlingame, Calif. / Page 21 / L. C. Cole, Inc.
- C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill. / Page 22 / Reincke, Meyer, & Finn.
- Dynacor, Inc., a Subsidiary of Sprague Electric, 1014 Westmore Ave., Rockville, Md. / Page 25 / Stuart Sande.
- General Electric Co., Semi-conductor Div., Electronics Park, Syracuse, N.Y. / Page 23 / Brooke, Smith, French, and Dorrance.
- National Cash Register Co., Dayton 9, Ohio / Page 32 / Mc Cann-Erickson, Inc.

- Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa. / Page 3 / Maxwell Associates, Inc.
- Radio Corp. of America, Electronic Data Processing Div., Camden 2, N.J. / Page 27 / Al Paul Lefton Co., Inc.
- Radio Corp. of America, Industrial Electronic Products, Camden 2, N.J. / Page 5 / Al Paul Lefton Co., Inc.
- The Ramo Wooldridge Laboratories, 8433 Fallbrook Ave., Canoga Park, Calif. / Page 17 / The McCarty Co.
- Space Technology Laboratories, Inc., P.O. Box 95004, Los Angeles 45, Calif. / Page 2 / Gaynor & Ducas, Inc.
- System Development Corp., 2406 Colorado Ave., Santa Monica, Calif. / Page 31 / Stromberger, La Vene, McKenzie.
- Technical Operations, Inc., 3520 Prospect St., N.W., Washington 7, D.C. and 305 Webster St., Monterey, Calif. / Pages 28 and 29 / Dawson MacLeod & Stevens.



e, Jr.,  
a corp.  
emory.  
nceton,  
/ An  
mount,  
N.J. /  
message  
addon-  
Del. /  
Charles  
N.J. /  
al mem-  
Charles H.  
N.J. /  
al mem-  
Phila.  
corp. of  
a induc-  
John P.  
ry Rand  
lay flop  
Phila.  
corp. of  
ating on  
verbeek  
h Amer-  
rk, N.Y.  
hall, Pa.  
Mich. /  
Oreland,  
it, Mich.  
D Wissa-  
Maxwell  
rocessing  
ton Co.  
Products,  
, Inc.  
Fallbrook  
Carty Co.  
x 95004  
ucas, Inc.  
ve., Santa  
ene, Me  
, N.W.  
Monterey,  
& Stivers  
uary, 1960



## Computer Programmers:

### *Tired of standing on the sidelines?*

If you are content to work *for* instead of *with* other staff members, System Development Corporation is not for you. But, if you are ready to come off the sidelines and get in the thick of things, you should definitely consider SDC—where programming is a primary function rather than a service activity.

In addition to developing large computerized control systems for SAGE, SAC, and other important operations—SDC is engaged in a number of long-range research projects. They include: automatic coding and problem-oriented languages; development of a language to automate transition from one computer to another; study of the organization of large systems; investigation of computer design from a standpoint of programability rather than engineering; information retrieval and medical data processing.

Positions now open at all levels  
(at Santa Monica, California and Lodi,  
New Jersey)

The extension of SDC's programming activities into new areas has created openings for Programmers at various levels of experience, including senior status. Please send your inquiry to Mr. E. A. Shaw, SDC, 2406 Colorado Avenue, Santa Monica, California.

.....  
"Project CLIP—The Design of a Compiler and Language for Information Processing," a paper by Harvey Bratman of SDC's Data Processing Research staff, is available upon request. Send request to Mr. Bratman at SDC.  
.....



**SYSTEM DEVELOPMENT  
CORPORATION**

Santa Monica, California • Lodi, New Jersey



## NATIONAL'S CITY WITHIN A CITY... its community of scientists could include you!

Few organizations offer more challenging opportunities for research and development work than The National Cash Register Company, Dayton, Ohio. Encompassing all sciences, National's Research Division is built on the philosophy that Progress is limited only by man's imagination... that research is the first step in Progress. Why not investigate the possibilities of working in one of these fields:

- ELECTRONICS & DATA PROCESSING
- ELECTRONIC ENGINEERING DEVELOPMENT
- CHEMISTRY
- SOLID STATE PHYSICS

National's Research and Development Center is located at its production and sales headquarters in Dayton, Ohio.

**THE NATIONAL CASH REGISTER COMPANY, DAYTON 9, OHIO**

**ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS**

**76 YEARS OF HELPING BUSINESS SAVE MONEY**

FOR COMPLETE INFORMATION simply send your resume to Mr. T. F. Wade, Technical Placement Section F-9, The National Cash Register Company, Dayton 9, Ohio. All correspondence will be kept strictly confidential.

\*TRADEMARK REG. U.S. PAT. OFF.

*National*

VERSATILE DATA PROCESSING  
DIVERSIFIED CHEMICAL PRODUCTS  
ADDING MACHINES • CASH REGISTER  
ACCOUNTING MACHINES • NCR PAPER

ATION  
Mr. T. F.  
t Section  
ster Com  
rrespond  
fidentia

T. OFF.

al  
ING  
DUCTS  
GISTER  
R PAF